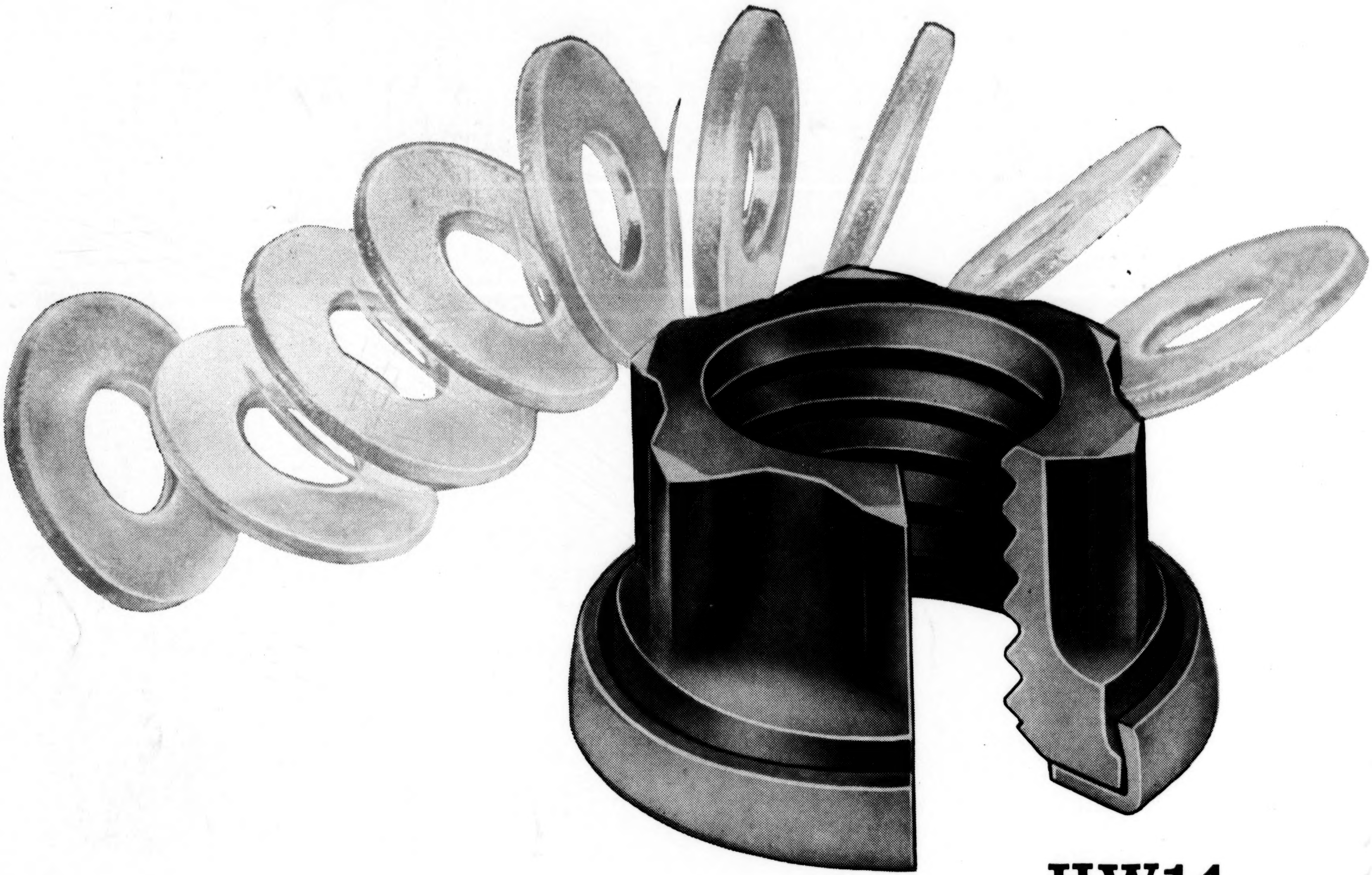
viation Week
and Space Technology
A McGraw-Hill Publication
December 4, 1961

SPECIAL REPORTS:

- Radiation Weapons
- Hawk Missile

UNIV. OF MICH.
DEC 4 1961
LAW LIBRARY

Beech Model 23 Musketeer

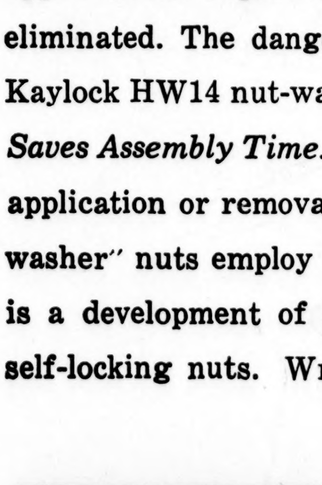


HW14

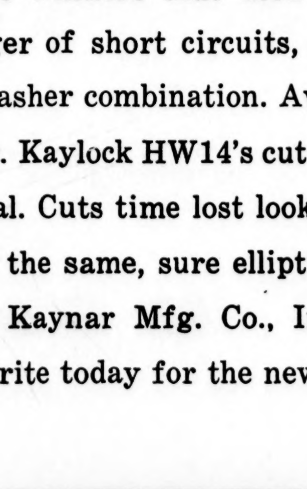
Kaylock® 'captive washer' nut gains wide acceptance!

Since its introduction early in 1960, this new Kaylock® lightweight, all-metal self-locking nut with integral free-spinning metal washer has been specified by leading aerospace manufacturers for an increasing number of applications. Separate washers that used to drop off, roll away, and slide into hard-to-get-at places have been eliminated. The danger of short circuits, due to these forgotten washers, also has been eliminated by the new Kaylock HW14 nut-washer combination. Available in carbon steel or A286 corrosion-resistant steel.

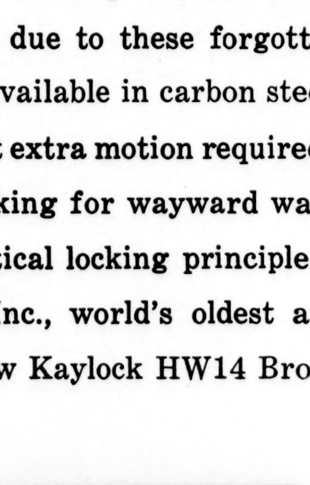
Saves Assembly Time. Kaylock HW14's cut extra motion required to put washer on bolt. Washer can't drop off during application or removal. Cuts time lost looking for wayward washers..*to zero! Safer, too!* Kaylock HW14 "captive washer" nuts employ the same, sure elliptical locking principle to prevent vibration hazards. The Kaylock HW14 is a development of Kaynar Mfg. Co., Inc., world's oldest and largest manufacturer of lightweight, all-metal self-locking nuts. Write today for the new Kaylock HW14 Brochure—or call your nearest Kaylock representative.



The Kaylock HW14 is available in size -02 (shown above) and in other sizes to -6



View of Kaylock HW14-3 and washer prior to assembly.



Assembled HW14-3. Integral, free-spinning washer can't drop off. Only one part to handle instead of two.

Kaylock®
first in lightweight locknuts

KAYNAR MFG. CO., INC., KAYLOCK DIVISION
Box 2001, Terminal Annex, Los Angeles 54, Calif. Branch offices, warehouses & representatives in Wichita, Kan.; New York, N.Y.; Atlanta, Ga.; Renton, Wash.; Montreal; Paris; London; The Hague

Trade Mark

AEROSPACE CALENDAR

Dec. 6–43rd Annual Industrial Preparedness Meeting, American Ordnance Assn., Waldorf-Astoria, New York, N. Y.

Dec. 12-14–Eastern Joint Computer Conference, Sheraton Park Hotel, Washington, D. C.

Dec. 18–25th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Jan. 8-12–1962 Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit.

Jan. 9-11–Eighth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.

Jan. 15-17–Symposium on Optical Character Recognition, Department of the Interior Auditorium, Washington, D. C. Sponsored by Information Systems Branch/Office of Naval Research and Research Information Center/National Bureau of Standards.

Jan. 16-18–Eighth Annual National Meeting, American Astronautical Society, Sheraton-Park Hotel, Washington, D. C.

Jan. 21-24–Annual Meeting, Helicopter Assn. of America, Marriott Motor Hotel, Dallas, Tex.

Jan. 22-24–30th Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 23.

Jan. 23-26–Third Annual Solid Propellant Rocket Conference, American Rocket Society, Baylor University, Waco, Tex.

Jan. 24-26–Second Symposium on Thermo-

(*Continued on page 6*)

AVIATION WEEK and Space Technology

December 4, 1961

Vol. 75, No. 23

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator; Daniel F. Crowley, Vice President and Controller. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

Available only by paid subscription. Publisher reserves the right to refuse non-qualified subscriptions. Subscriptions to Aviation Week solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription orders forwarded to address shown in box below.

Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada, $8 one year. All other countries, $20 one year.

Our primary aim is to provide subscribers with a useful and valuable publication. Your comments and suggestions for improvement are encouraged and will be most welcome. The publisher, upon written request, agrees to refund the part of the subscription price applying to the remaining unfilled portion of the subscription—if service is unsatisfactory.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.

©Copyright 1961 by McGraw-Hill Publishing Co., Inc. All rights reserved.

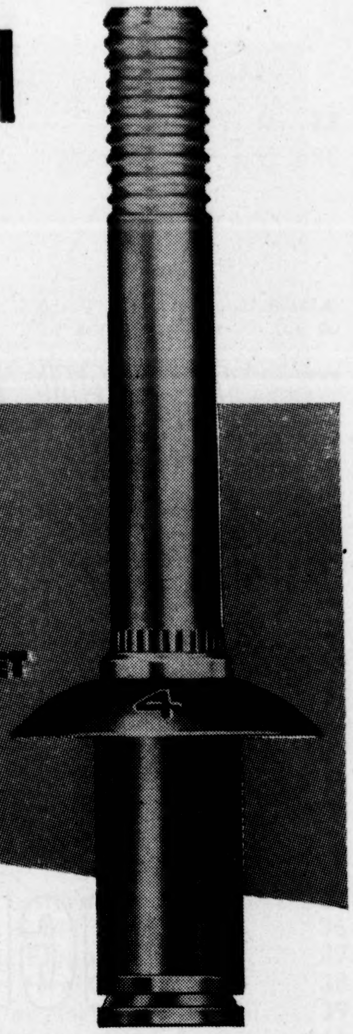
Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK and SPACE TECHNOLOGY are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscribers: Send correspondence and change of address to Fulfillment Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Fulfillment Manager, Aviation Week and Space Technology, 330 West 42nd Street, New York 36, N. Y.

SOLID RIVET STRENGTH WITH BLIND RIVETS

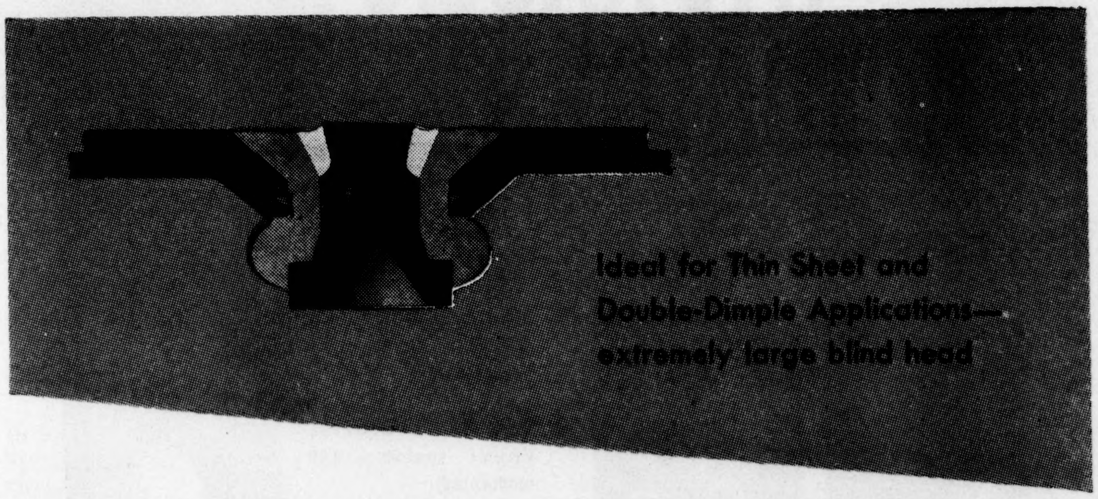
CHERRYLOCK RIVETS for Your Difficult Solid Rivet Applications



BULBED CHERRYLOCK

ONLY THE BULBED CHERRYLOCK RIVET GIVES YOU ALL THESE ADVANTAGES

Mechanically Locked Stem • Flush Fracture (No Stem Trimming) • Positive Clamp-Up • Full Grip Range • Complete Hole Fill • Minimum Blind Side Clearance • Positive Visual Inspection (Grip Length Marked on Head)



Ideal for Thin Sheet and Double-Dimple Applications—extremely large blind head

The Bulbed Cherrylock* offers a blind rivet that installs and performs like a solid rivet. Bulbed Cherrylock Rivets will qualify where you are now using solid rivets, offering higher joint strength with greatly increased joint reliability under critical loading conditions—fatigue, shake and sonic vibration.

Now Cherrylock rivets give you a blind rivet that can be used in expensive forgings as well as for joining and attaching sheets and components.

For technical data on Cherrylock Rivets, write Cherry Rivet Division, Townsend Company, Box 2157N, Santa Ana, California.

Cherry Rivet Division

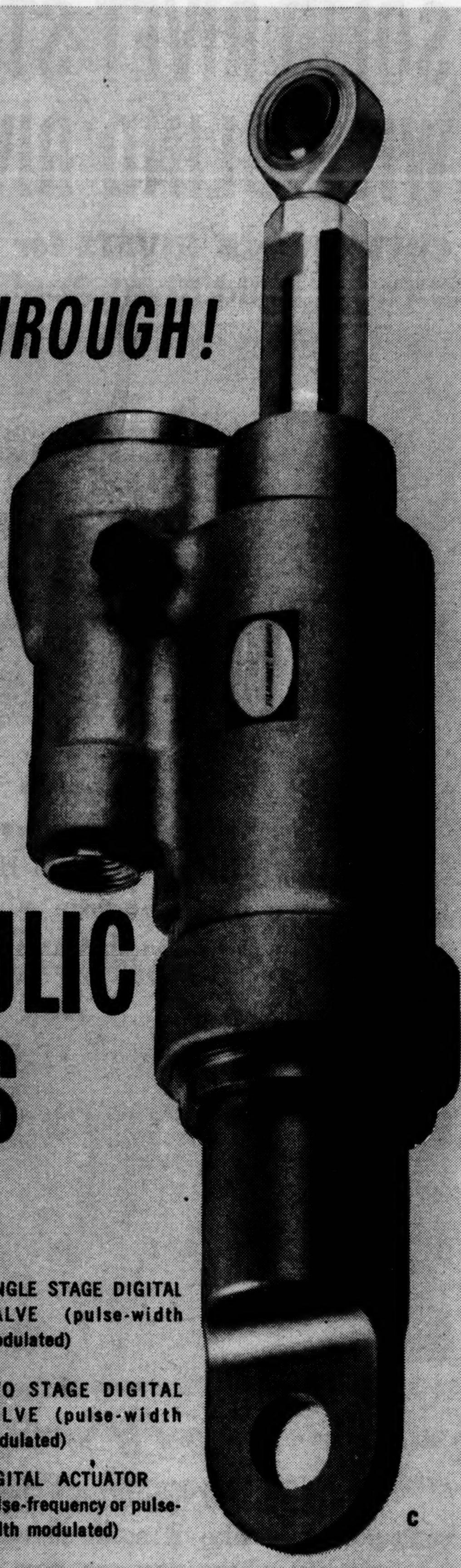
Santa Ana, Calif.

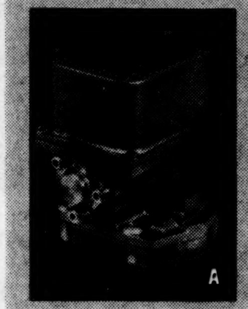
* Patent Pending

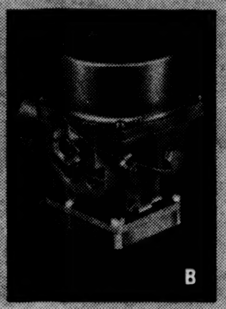
Townsend Company

ESTABLISHED 1816 • BEAVER FALLS, PA. • A textron COMPANY

In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario







DESIGN BREAKTHROUGH!

DIGITAL HYDRAULIC ACTUATORS

A. SINGLE STAGE DIGITAL VALVE (pulse-width modulated)

B. TWO STAGE DIGITAL VALVE (pulse-width modulated)

C. DIGITAL ACTUATOR (pulse-frequency or pulse-width modulated)

HERE'S A NEW METHOD OF HYDRAULIC VALVING THAT NOW GIVES YOU THESE IMPORTANT BENEFITS

WEIGHT SAVINGS . . . with zero neutral leakage ■ RELIABILITY . . . with larger contamination tolerances ■ SIMPLIFICATION . . . with elimination of analog-to-digital converters ■ FASTER RESPONSE . . . with pulse frequencies up to 200 PPS ■ APPLICATIONS: pulse-frequency modulated digital system ■ pulse-width modulated digital system ■ analog system using contactor loop. Digital hydraulic valves and actuators are in the "hardware stage" at LTV Electronics and can be supplied to meet your particular needs on short notice. For specific performance data, inquire today giving us your system requirements. Demonstration of operational actuators and valves may be arranged on request. Write P. O. Box 6118, Dallas 22, Texas.

LTV ELECTRONICS DIVISION
LING-TEMCO-VOUGHT, INC.

AEROSPACE CALENDAR

(*Continued from page 5*)

physical Properties, Princeton, N. J. Sponsor: Heat Transfer Division, American Society of Mechanical Engineers.

Feb. 6-7—Symposium on Redundancy Techniques for Computing Systems, Department of the Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Feb. 19-21—Range Reconnaissance and Tracking of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.

Feb. 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Tex. Sponsors: South Texas Section-Society for Nondestructive Testing; Southwest Research Institute.

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

Mar. 1-3—Eighth Scintillation and Semiconductor Counter Symposium, IRE, Shoreham Hotel, Washington, D. C.

Mar. 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

Mar. 8-9—Institute of the Aerospace Sciences' Flight Propulsion Meeting (classified), Cleveland, Ohio.

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Claremont, Berkeley, Calif.

Mar. 26-29—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria, New York.

Mar. 28-29—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers; Institute of the Aerospace Sciences; Institute of Radio Engineers; University of Rochester.

Apr. 1-4—Mid-Year Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 3-5—Launch Vehicles: Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.

Apr. 3-6—National Aeronautic Meeting (including production forum), Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 10-12—Second Symposium on Th Plasma Sheath—Its Effect Upon Re-entry Communication and Detection, New England Mutual Hall, Boston, Mass. Sponsor: AF Cambridge Research Laboratories.

Apr. 11-13—Southwestern Conference and Electronics Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.

Apr. 16-18—Second International Fligh Test Instrumentation Symposium, Colleg of Aeronautics, Cranfield, England.

December 4, 1961

Aviation Week and Space Technology

Vol. 75, No. 23
Member ABP and ABC

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035) **Washington 4, D. C.**—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630 **Los Angeles 17**—1125 West Sixth St., Phone: HUntley 2-5450 **Dallas 1**—1712 Commerce St., Phone: RIverside 7-9721 **European Office**—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63 **London Office**—34 Dover St., London W.1, England, Phone: Hyde Park 1451

PUBLISHER...........**Robert W. Martin, Jr.**
EDITOR....................**Robert B. Hotz**

MANAGING EDITOR.......William Gregory
TECHNICAL EDITOR......David A. Anderton
EUROPEAN EDITOR.........Cecil Brownlow

BUREAU CHIEFS
WASHINGTON.................Evert Clark
LOS ANGELES ....Irving Stone
DALLAS.................Erwin J. Bulban
LONDON..............Herbert J. Coleman

DESK EDITORS..............Harry Raven, Arnold Sherman, David A. Brown, Richard G. O'Lone
AVIONICS EDITOR..........Philip J. Klass
ASSISTANTS...Barry Miller, George Watson
TRANSPORT EDITOR............L. L. Doty
ASSISTANTS Glenn Garrison, Robert H. Cook, David H. Hoffman, Ward Wright
ENGINEERING............Russell Hawkes, William S. Reed
SPACE TECHNOLOGY.....Edward H. Kolcum, George Alexander
MILITARY EDITOR............Larry Booda
BUSINESS FLYING........Erwin J. Bulban, Andrew A. Keil
CONGRESS..............George C. Wilson, Katherine Johnsen
EQUIPMENT...........James D. Hendricks
ART EDITOR.............Lawrence J. Herb
ASSISTANT...................Anne Liuzzo
EDITORIAL PRODUCTION......Frank Miazga
ASSISTANT EDITORS........Edith Walford, Ann Dunphy
EDITORIAL ASSISTANTS......Marjorie Todd, Madge Hammond
LIBRARIAN............Theresa V. Maggio

FOREIGN NEWS SERVICE
EDITOR...................John Wilhelm
PARIS..................Robert E. Farrell
MOSCOW...................Ernest Conine

DOMESTIC NEWS BUREAUS
ATLANTA 9.......1375 Peachtree St., N.E.
CHICAGO 11........645 No. Michigan Ave.
CLEVELAND 13..1164 Illuminating Building
DETROIT 26...........856 Penobscot Bldg.
HOUSTON 25........W-724 Prudential Bldg.
SAN FRANCISCO 11......255 California St.

SALES
ADVERTISING SALES MANAGER E. P. Blanchard, Jr.
ATLANTA...................R. H. Powell
BOSTON...................A. C. Boughton
CHICAGO and ST. LOUIS......J. S. Costello, D. C. Jackman
CLEVELAND.............T. H. Hunter, Jr.
DALLAS.....................John Grant
DENVER...................John G. Patten
DETROIT.....................M. Hulburd
HOUSTON........................J. Page
LOS ANGELES...........C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK..................M. J. Storz, R. Wallace, J. D. Warth
PHILADELPHIA..J. D. Willis, J. M. Tannehill
PITTSBURGH..................J. R. Pierce
SAN FRANCISCO..............R. R. Butera
PROMOTION MGR............C. C. Gersna
EUROPEAN MARKETING DIRECTOR Fulvio Piovano
RESEARCH & MARKETING Rosalie Christesen, Patricia W. Abrams
MERCHANDISING..............J. R. Gerardi

BUSINESS
BUSINESS MANAGER.......J. G. Johnson
CIRCULATION MANAGER........T. J. Lucey
ASST. BUSINESS MANAGER...W. V. Cockren
PRODUCTION MANAGER........F. A. Dube

North American to Build Apollo Spacecraft........ 26

▶ Largest NASA contract goes to its biggest supplier; $400-million initial figure will cover 10 vehicles.

Shuttle Boosts Eastern's Holiday Traffic......... 36

▶ Expanded fleet makes fast turnarounds, doubling line's 1960 Thanksgiving commuter circuit volume.

U. S. Increases Radiation Weapons Studies......... 52

▶ Exotic weapons studied as a possible defense against ICBMs; considerable research effort centers on the use of plasmas.

SPACE TECHNOLOGY

North American to Build Apollo..... 26
Apollo Bio-instrumentation Award... 26
Chimp Shot Raises U. S. Hope........ 27
UN Space Group's Usefulness in Doubt 29
Particle Accelerator Aids Research.. 91
Project Mercury Test Flights........ 92

MISSILE ENGINEERING

Titan, Atlas Launches............. 33
Polaris Compared With Soviet Missiles 33
Tactical Mobility Stressed in Hawk... 74
Production Briefing 83

AERONAUTICAL ENGINEERING

Ryan to Build Fan-in Wing Aircraft.. 29
Convertiplane Sets Six Records...... 32
GEM Concepts Advance............. 34

AVIONICS

U. S. Studies Radiation Weapons..... 52
Plating of Micro Wafers Tested..... 67
Filter Center 73

BUSINESS FLYING

Beech to Market Musketeer in 1963.. 94
Peru Purchases Cessna Fleet........ 107
Piper Aims for Low Aircraft Costs... 108
Aircraft Shipments—August, 1961... 109
Private Lines 109

AIR TRANSPORT

Shuttle Boosts Eastern's Holiday Traffic 36
Halaby Studies C-141 Rift.......... 36
Airline Pooling Proposals.......... 37
CAB to Outline Fare Changes........ 38
Hughes Insists on Northeast Control.. 39
BUA, Cunard Win New Routes........ 41
Fuel Line Investigated in Vertol Mishap 45
Supersonic Caravelle Funding....... 45
Growth Perils Australian Air Policy.. 47
Airline Income and Expenses........ 49
Airline Observer 50
Shortlines 50

MANAGEMENT

North American Research Projects... 26
Varied Groups Deal With Pentagon.. 30
DOD to Revise Contact Set-up....... 30
DOD Non-profit Organization Policy.. 31
UK to Support Air Industry......... 32
General Disarmament Theme Outlined 32
General Dynamics Executives Resign. 34
L-T-V Combines Divisions.......... 35
Industry Observer 23
Who's Where 23
Washington Roundup 25
News Digest 35

FINANCIAL

El Al Financing.................. 41
BUA Fiscal Report................ 89
New Offerings 89

Calendar 5
Letters 120

EDITORIAL

Air Shuttle Performance........... 21

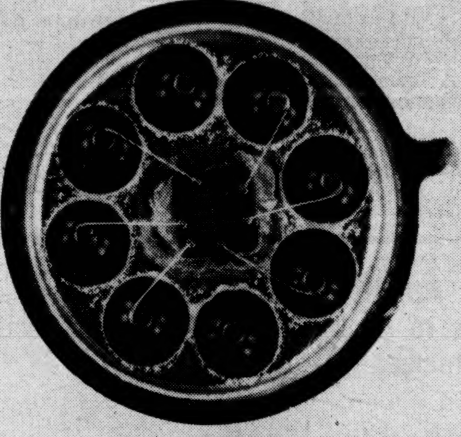
COVER: Beech Aircraft Corp.'s newest airplane, the Model 23 Musketeer, recently made its first flight at Wichita, Kan. The four-place airplane is expected to sell for approximately $12,000. It features bonded honeycomb construction in the wing. See p. 94 for story and other photos.

PICTURE CREDITS

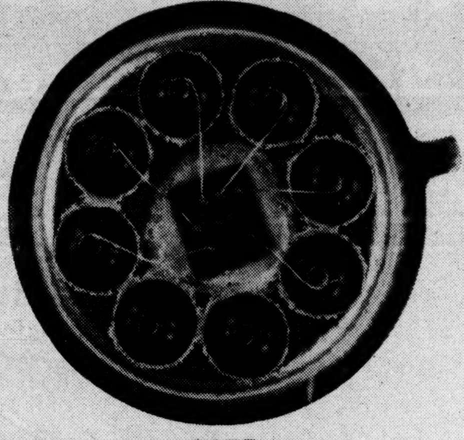
Cover—Jack Haworth, Beech Aircraft; 27, 28—Wide World; 29—Ryan Aeronautical Co.; 33—UPI; 47—de Havilland Aviation Co.; 48—BEA; 52 (left), 55—Bendix Aviation Co.; 52 (right)—Hughes; 53—Minneapolis-Honeywell; 69—Philco; 74—Raytheon; 75—David A. Anderton; 77—RCAF; 81—Dassault; 91—Ling-Temco-Vought; 94, 95, 99, 105—Beech Aircraft Co.; 108, 109—Piper Aircraft Co.

86,560 copies of this issue printed

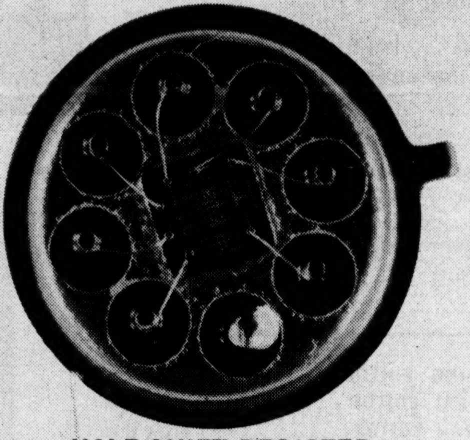
UNRETOUCHED PHOTOGRAPHS MAGNIFIED 4⅔ TIMES



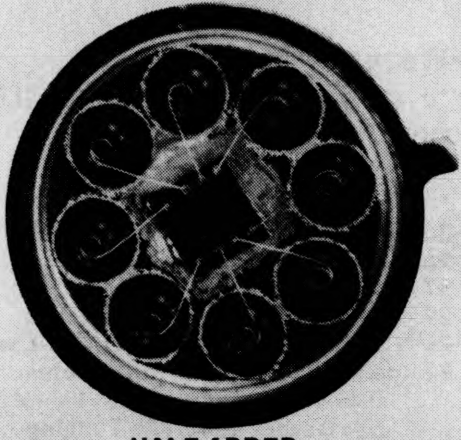
FLIP-FLOP
"F" Element



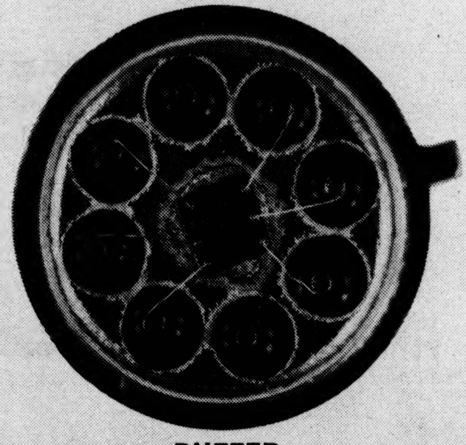
GATE
"G" Element



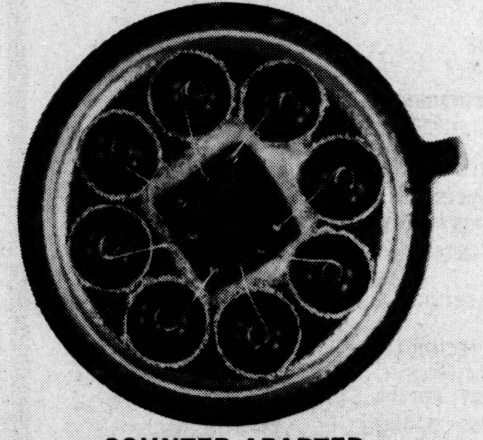
HALF-SHIFT REGISTER
"S" Element



HALF-ADDER
"H" Element



BUFFER
"B" Element



COUNTER ADAPTER
"C" Element

MICROLOGIC ELEMENTS

are a compatible set of integrated digital functional blocks in which transistors and resistors are diffused via the Planar process into a single, monolithic chip of silicon. This family of functional elements is sufficient to efficiently fabricate a computer logic section. No other components are required.

They are designed to operate in a full military environment, over a temperature range of −55 degrees C to +125 degrees C. When integrated into a computer, they will operate at 1 mc clock rates over the above temperature range.

Micrologic elements are designed primarily to permit highly reliable data processing logic at very low cost. They make possible a simplified approach to the job and hence greatly reduce the lead time to the prototype computer.

The cost savings are to computer manufacturers and the computer user. The choice of the elements and the nature of the package, are great factors in the total cost reduction associated with the reliability, maintainability, repairability, logistics, and training.

The size reduction (one order of magnitude) gained with Micrologic is an important by-product of the main objectives of the program.

IMMEDIATE AVAILABILITY

All 6 Micrologic elements are available **now** for immediate volume delivery. Contact your Fairchild Field Sales Office.

90% COST REDUCTIONS
IN LOGIC DESIGN & ASSEMBLY

Micrologic elements can cut logic system design and assembly costs up to 90%; space requirements up to 95%; power needs up to 75%. These savings are made possible through simplified layouts, standard handlings of TO-5 type packages, fewer interboard connections, single clocks, one power supply.

PLANAR RELIABILITY

Fairchild Micrologic elements have been life tested for 1,000,000 element operating hours at 125° C without a single electrical failure. The Fairchild Planar process provides total protection with its integral oxide surface.

FAIRCHILD
SEMICONDUCTOR
545 WHISMAN ROAD, MOUNTAIN VIEW, CALIF. • YORKSHIRE 8-8161 • TWX: MN VW CAL 853
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

GENERAL SPECIFICATIONS FOR MICROLOGIC ELEMENTS

Speed	• 50 nsec. delay per stage for all loads (1 mc clock rates over temp. range of —55°C. to +125°C.)
Power	• 15 mW per node
Fan Out	• 5* over temp. range of —55° C. to +125° C.
Voltage	• 3 V ±30%
Package	• 8 lead TO-5 type (.170 height)

*The buffer element has a fan out of 25

μL and μLogic are trademarks of Fairchild Semiconductor, a Division of Fairchild Camera and Instrument Corporation

EDITORIAL

Air Shuttle Performance

The air shuttle operated by Eastern Air Lines from the New York hub to Washington and Boston received its first severe test during the recent Thanksgiving holiday when it handled all of a substantial overload without a hitch and without any passenger being denied a seat. For details of this operation, read Glenn Garrison's report on page 36 of this issue.

During this Thanksgiving holiday super-shuttle service, Eastern carried its 400,000th passenger since the no-reservation, guaranteed-seat, low-fare shuttle began between New York, Washington and Boston last Apr. 30.

As a frequent Washington-New York commuter, we have been a regular fare-paying customer on this service since it began; first, for on-the-spot observation of a basic new step in air transportation and now, like so many others, as a satisfied customer who has found that the service offers a great boon to the busy, regular air traveler.

Slow Fruition

The air bus concept of offering high frequency, no-frills low-fare service between large metropolitan areas kicked around the airline business for several years. Hal Carr, of North Central Airlines, sniffed some of this potential with the results of his high-frequency scheduling between Chicago and Milwaukee, although it was still a standard fare, advanced reservation service and the capacity of his DC-3 aircraft limited its exploitation. Les Barnes, of Allegheny Airlines, took another step in this direction with his no-reservation, low-fare standby service on a high-frequency Pittsburgh-Philadelphia service with Napier-powered Convairs.

Passenger acceptance of both these services was high almost from the start, and has shown good growth. Jimmy Pyle, then deputy administrator of the Federal Aviation Agency, also used to plump for an air bus service in his public speeches through the hinterlands.

It remained for Eastern Air Lines to pioneer the first full-scale experiment in air bus technique with its operations that began last Apr. 30 from the New York hub along high-density traffic spokes to Washington and Boston. The service began modestly with flights each way every two hours between 8 a.m. and 10 p.m. As public acceptance grew, and commuters found that the guaranteed seat was indeed guaranteed—even if a second section had to be flown for a single customer—the service was expanded to every hour on the hour for all three points. Although the Thanksgiving holiday produced a true shuttle, with planes operating almost continuously with as little as 9 min. turnaround time, the extra section has become fairly routine during the peak periods of the commuters' week such as Monday morning and Friday evening.

Although the price is cheaper than standard first-class fare, we feel that it is convenience rather than the lower price that is the principal attraction for the Eastern shuttle. The elimination of reservations, preflight ticketing, counter check-in, and baggage tagging saves a tremendous amount of time and schedule straining for the air commuter. The on-the-hour scheduling plus the assurance of the extra section eliminates all of the strain of fighting for a seat, bucking the standby line, or playing the multiple reservation, no-show game. However, for the frequent traveler, the small individual ticket fare savings multiply significantly over a six-month period. The on-time departure record has been good and Eastern service representatives do an efficient job of initiating all customers into the shuttle ritual.

The big question in the air transport industry is whether this type of air shuttle service can be profitable. Eastern's President Malcolm MacIntyre guards the shuttle statistics personally and has stated to the Civil Aeronautics Board that the operation is "marginally profitable" in seeking a $1 fare increase.

A Matter of Convenience

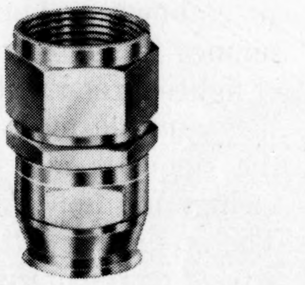
We don't think a $1 per ticket fare increase is going to diminish the present popularity of the air shuttle because convenience is its primary drawing card. We have noted a wide broadening of the economic spectrum of air shuttle passengers in the six months in which we have been riding it regularly. Recently we sensed a heavier percentage of obviously executive traffic and find more familiar faces going the same way about the same time each week. Although the bulk of Eastern's record holiday traffic consisted of vacationing college students, we have also observed uniformed personal chauffeurs meeting shuttle passengers in both Washington and New York.

The September shuttle statistics showing 50,845 passengers moving between New York and Boston, and 41,745 people flying between Washington and New York, are impressive evidence of how volume traffic can develop.

Eastern's air shuttle service experimental period has been extended by the CAB until April of 1962 when a full year's operation will be on the record for all to study. We think CAB showed good sense in its original authorization for somebody to attempt a full-scale shuttle operation.

We predict the air shuttle will become a permanent part of the air transport scene as a major step forward in providing the traveling public with service of better convenience and utility.

—Robert Hotz



The ***"super gem"**** Detachable Reusable Fitting

now the USAF standard

field attachable fitting

for hose of Teflon†

*Aeroquip Trademark

†DuPont Trademark

WHO'S WHERE

In the Front Office

Dr. Herbert F. York, Chancellor of the University of California at San Diego, elected to the Board of Trustees of Aerospace Corp., Los Angeles, Calif. Other Aerospace appointments: **V. G. Nielsen**, secretary; **W. Bruce Garoutte**, assistant treasurer.

Paul B. Wishart, board chairman and chief executive officer of Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., succeeding **Harold W. Sweatt**, now chairman of the finance committee. **James H. Binger** succeeds Mr. Wishart as president; **Stephen F. Keating** was elected to the newly created third executive vice presidency.

Wilson L. Fenn, board chairman, and **James P. Gantley**, vice chairman, The Fenn Manufacturing Co., Newington, Conn. Mr. Fenn continues as president.

F. E. Newbold, Jr., corporate director of Fairchild Stratos Corp.'s newly established Washington (D.C.) Operations. Mr. Newbold continues as a vice president and director of the corporation and general manager of the Stratos Division.

Nelson B. Fry, Jr., senior vice president and general manager of Allegheny Airlines. **L. Thomas Ferguson** replaces Mr. Fry as acting vice president-sales and service.

Gerald W. Crisman, president, GEMCO, Inc., Washington, D. C.

Paul W. Leake, president, Shinn Engineering, Inc., Santa Ana, Calif. **John Meisenbach** succeeds Mr. Leake as vice president.

William W. Wright, executive vice president-administration, Beckman Instruments, Inc., Los Angeles, Calif., and **Robert M. Ward**, vice president-planning and supervision of the corporate operating staff.

Associated Testing Laboratories, Inc., Wayne, N. J., has appointed the following as vice presidents: **Robert Goldsmith** for contracts engineering; **Jack C. Korman** in charge of the Southeastern Division, Winter Park, Fla.; **Daniel N. Schochet** for research and development; **John E. Stryker** in charge of the Manufacturing Division.

Arthur X. Schmaltz, treasurer, Brooks & Perkins, Inc., Detroit, Mich.

Arthur F. Flood, vice president-administration, Kollsman Instrument Corp., Elmhurst, N. Y., a division of Standard Kollsman Industries, Inc.

Dr. Frank Moothart, group controller, Litton Systems, Inc., Beverly Hills, Calif., a subsidiary of Litton Industries, Inc.

The Federal Aviation Agency has named **Paul F. Steiner** manager of Washington National Airport.

Col. Edgar E. Bartlett, chief, Strategic Air Command Systems Office, Norton AFB.

Honors and Elections

Dan A. Kimball, president of Aerojet-General Corp., has been elected chairman of the Board of Governors of the Aerospace Industries Assn. for 1962, and **William M. Allen**, president of the Boeing Co., has been elected vice chairman. **August C. Esenwein** was elected president of AIA, succeeding **Gen. Orval R. Cook** (USAF, ret.), retiring (AW July 17, p. 39).

(Continued on page 111)

INDUSTRY OBSERVER

▶ Army plans an attempt to demonstrate kill capability of its Nike Zeus anti-missile missile by firing it against a Nike-Hercules anti-aircraft missile at the White Sands, N. M., proving ground, probably before the middle of this month.

▶ Nord Aviation, which abandoned development of a ground-to-air missile when the French government decided to back the U. S. Army-Raytheon Hawk missile system, has begun a new program aimed at producing a light ground-to-air missile system for close support work. Nord also is redesigning its successful subsonic CT-20 target missile for use on army photo-reconnaissance missions.

▶ Mercury capsule for the first manned orbital flight, plus a backup capsule, already are at Cape Canaveral. Total number of capsules at National Aeronautics and Space Administration's facility there stood at four last week, including the one used for the orbital flight of a chimpanzee and a backup capsule for that flight (see p. 27).

▶ Apollo manned capsule's recovery system probably will consist of three parachutes. NASA now appears to favor the glide-sail principle proposed by Radioplane Division of Northrop Corp., which consists of a parachute with a flexible flap for steering, over the Rogallo wing approach for recovery (AW Nov. 6, p. 29).

▶ Atlas E test program will include four launchings beyond the one scheduled for late last week, which was to carry a biological piggyback experiment. This will end the test series for all models except the F. Two F models have been fired so far and launches are scheduled throughout Calendar 1962, using Cape Canaveral Pad 11 only.

▶ First NASA-Grumman orbiting astronomical observatory (OAO) is now in static test. Vibration surveys are to begin in January and thermal vacuum tests are slated for March. First three of the five spacecraft being built will be used for ground testing.

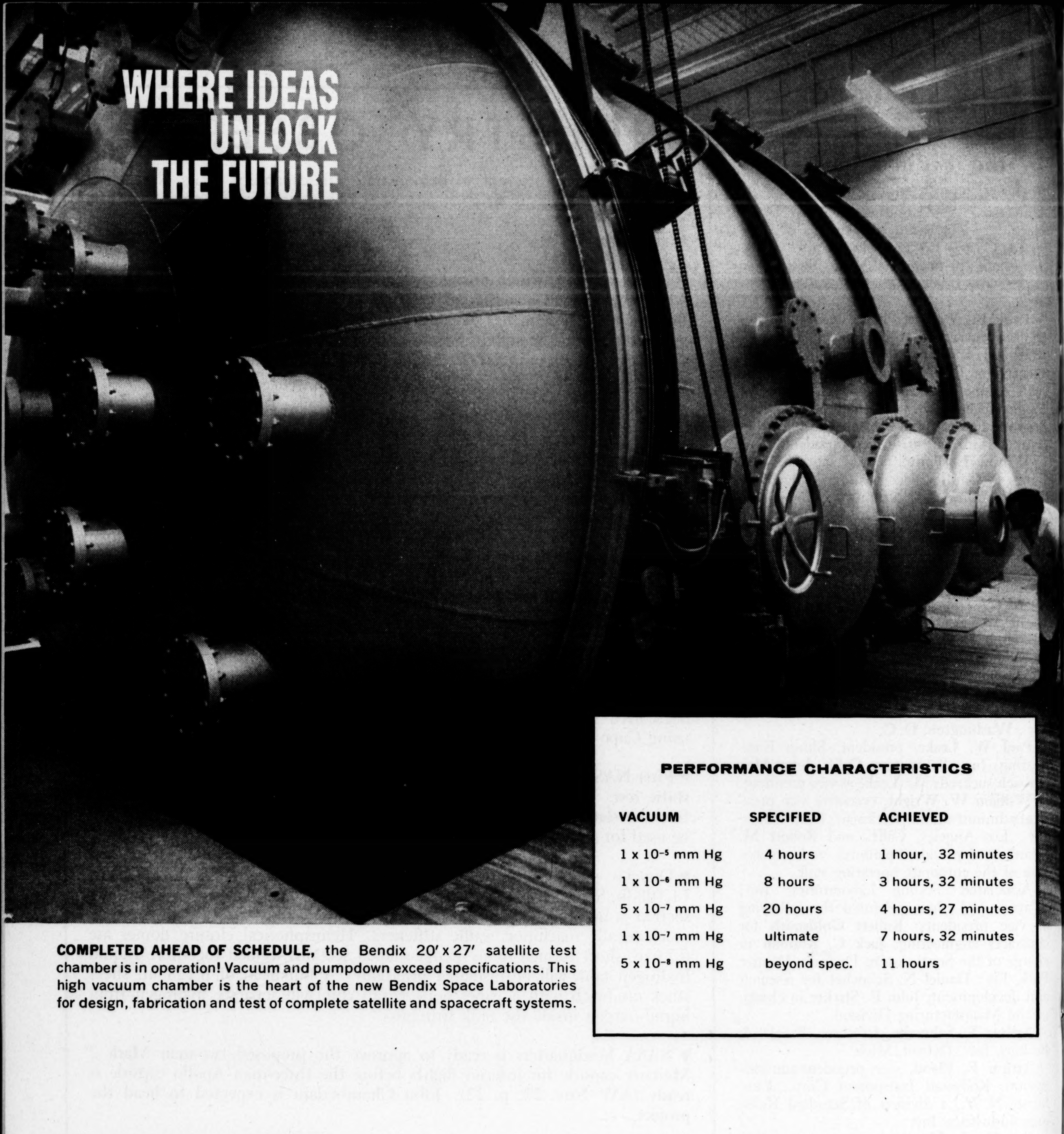
▶ Douglas plans to meet the rigorous weight requirements for NASA's 11,500-lb. Saturn S-4 stage by using conventional materials. Cylindrical tank section is made of three 0.5 in. thick aluminum alloy sheets with internal, mechanically machined waffle stiffeners. Hemispherical closure domes are 0.25 in. sheet formed of six wedge-shaped sections welded together. Liquid hydrogen tank will be insulated internally. A bulkhead of 0.125 in. sheet stock sandwich with a paper honeycomb core will separate hydrogen from liquid oxygen inside the tank structure.

▶ NASA headquarters is ready to approve the proposed two-man Mark 2 Mercury capsule for interim flights before the three-man Apollo capsule is ready (AW Nov. 27, p. 22). John Chamberlain is expected to head the project.

▶ Failure of Ranger 2 (AW Nov. 27, p. 27) apparently resulted from a stabilization problem that allowed the Agena rocket stage to spin, throwing the propellants to the outsides of the tanks. Even use of the ullage rockets did not overcome the centrifugal force causing the propellants to hold to the tank walls. The engine fired, but could burn only the propellants already in the lines.

▶ Russians are fitting all-metal A-13 high-performance sailplanes with small jet auxiliary powerplants to extend the duration of soaring flights and to assist in returning to point of takeoff.

▶ NASA will ask for bids soon through Army's Corps of Engineers for architectural engineering proposals on a second launching pad for the Atlas-Centaur vehicle at Cape Canaveral, Fla. Pad is numbered 36B and will be served by the existing launch tower now serving 36A. Pad 13, which has been used for USAF-Convair Atlas research and development firings, will be modified to handle Atlas-Agena space shots.



COMPLETED AHEAD OF SCHEDULE, the Bendix 20′ x 27′ satellite test chamber is in operation! Vacuum and pumpdown exceed specifications. This high vacuum chamber is the heart of the new Bendix Space Laboratories for design, fabrication and test of complete satellite and spacecraft systems.

PERFORMANCE CHARACTERISTICS

VACUUM	SPECIFIED	ACHIEVED
1×10^{-5} mm Hg	4 hours	1 hour, 32 minutes
1×10^{-6} mm Hg	8 hours	3 hours, 32 minutes
5×10^{-7} mm Hg	20 hours	4 hours, 27 minutes
1×10^{-7} mm Hg	ultimate	7 hours, 32 minutes
5×10^{-8} mm Hg	beyond spec.	11 hours

SPACE ENGINEERS experienced in integration, assembly and testing of satellites will find new careers at the Bendix Space Laboratories. Specialists are needed for thermal-vacuum, vibration, structures, dynamics, radio and noise interference, fluids and mechanics, instrumentation, circuit design, and field test. Write or call Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

Bendix Systems Division

THE Bendix CORPORATION

Washington Roundup

Army Space Potential

Watch for a closer working relationship between Army and Air Force in the attempt to broaden the military's role in space. Army's policy statement on what it considers its capabilities in space, given before a recent Air Force Scientific Advisory Board meeting (AW Nov. 27, p. 21), has aroused so much interest that space leaders in both services have been exploring the subject further.

Focal point of the interest is the two-year-old Horizon report on Army's space potential, ordered by then Army Chief of Staff Maxwell Taylor and prepared under the direction of then Maj. Gen. John B. Medaris, Wernher von Braun and Dr. Ernst Stuhlinger. The Horizon studies were discontinued when the Saturn booster and the Army's missile development team under von Braun were transferred to the civilian space agency. Maj. Gen. August Schomburg, head of the Army Ordnance Missile Command, passed out copies of the report at the advisory board meeting.

Renegotiation Battle

Campaign is building to limit the authority of the Renegotiation Board to take away what it considers excess profits made by contractors on government work. The effort is expected to come into the open early next year as Defense Department increases emphasis on use of incentive contracts (AW Nov. 20, p. 26). Defense witnesses will argue before the House and Senate armed services committees that incentive contracts will save money but will work only if the board gives immunity to the contractors involved.

The Renegotiation Act expires next June, so any arguments over incentive contracts will influence Congress' attitude on extending the board's life. Chairman Carl Vinson of the House Armed Services Committee is expected to fight any attempt to hobble the board.

Shakeup is coming within the Renegotiation Board. The Kennedy-appointed chairman, Lawrence E. Hartwig, already has streamlined procedures so that the board is more current in its workload than ever before. Now he is set to make sweeping reductions in staff.

Comsat Hearings

Chairman Robert Kerr of the Senate Aeronautical and Space Sciences Committee plans extensive hearings early in the next session on ownership of a communications satellite system. Sen. Kerr favors private ownership. As a send off for the hearings, he will introduce legislation authorizing a Satellite Communications Corp. with a capital stock of $500 million, available for purchase by carriers authorized by the Federal Communications Commission. Sen. Margaret Chase Smith of Maine will become the top Republican on the space committee as a result of Sen. Styles Bridges' death.

One of the recommendations in a report prepared at the President's request by retired USAF Gen. Earle E. Partridge on a national command and control system calls for a single operational military commander over the existing and planned unified commands. He would be named only after units such as a unified strategic command, continental defense command, sea defense command, etc. (AW Oct. 16, p. 34) had been formed, in line with the program package approach to defense planning. Others who have studied the problem, apparently including retired Army Gen. Maxwell Taylor and presidential adviser McGeorge Bundy, favor something more like the single chief of staff approach in which the single commander also would have control over policy and planning. Under the Partridge proposal, the single commander would report to the Joint Chiefs of Staff initially, with operational control being transferred to him gradually, until finally he reported directly to the Secretary of Defense.

Military Airlift Bid

Chances appear good that MATS will be given full control over all contract military airlift as a result of a request by Air Force Secretary Eugene Zuckert to Defense Secretary Robert McNamara. This authority is now held by the Army-managed Military Traffic Management Agency, which contracts with commercial carriers for short-term military airlift operations. Army will protest, but it has not developed a strong policy on the matter and the protest is not expected to carry much weight.

Airlines are concerned that the switch in authority also would mean a switch in military traffic from their systems to MATS, which MATS favors. Zuckert's request was based on McNamara's order that contracts with non-scheduled lines be made only after MATS had inspected the company's safety and reliability performance. Zuckert said such inspection would be simplified with MATS in complete control of the contracts.

Results of Project Highspeed, an evaluation held by Air Force to compare air superiority performance of the Navy-McDonnell F4H and the USAF-Convair F-106, have placed the F4H ahead in most categories. Air Defense Command, which began the project, was replaced by USAF's Aeronautical Systems Division in the second week of trials. F4H is expected to be in the Air Force budget for Fiscal 1963 not only as a tactical fighter but as an air defense fighter. Original programing of the F-106 is being described as a temporary decision. Meanwhile, Air Force is making an effort to give the F-106 greater ECM capability, probably through use of an underwing pod. **—Washington Staff**

North American to Build Apollo Spacecraft

Largest NASA contract goes to its biggest supplier; $400-million initial figure will cover 10 vehicles.

By Evert Clark

Washington—Selection of North American Aviation, Inc., to design and build 10 to 20 three-man Apollo spacecraft for flights that eventually will put U.S. astronauts on the moon means that National Aeronautics and Space Administration will begin negotiating this week the largest contract in its three-year history with the company that already is its largest contractor.

Initial contract will cover 10 vehicles and exceed $400 million. This is twice the amount of the initial contract NASA will negotiate with the Chrysler Corp. for the Saturn S-1 booster (AW Nov. 27, p. 22), which is the largest award previously made by NASA.

Choice of North American from among the five companies or teams that submitted bids early last October upset recent theories that the Kennedy Administration would place unusually great emphasis on dispersing space contracts widely among companies and geographical areas—particularly since it came 11 days after the Chrysler award, which was widely interpreted as an attempt to give the automobile industry a larger role in space development.

Of the five proposals submitted for Apollo, two were from firms or team leaders located in Southern California, two from the East and one from the Midwest. California holds a wide lead over all other states in the value of the NASA contracts its companies hold (AW Nov. 13, p. 30), and North American holds a wide lead over all other companies in value of NASA contracts—chiefly because its Rocketdyne Division is building the H-1 engines for Saturn, the F-1 engines for later Saturn models and the J-2 liquid hydrogen engine for Saturn upper stages. Rocketdyne also produces engines for the Atlas and Thor, which have been the workhorses so far in the military and civilian space program.

Bio-instrumentation

Los Angeles—Prototype short-distance communications and telemetry system capable of transmitting seven channels of physiological data from the body of an astronaut to a transceiver in a remote portion of an Apollo spacecraft will be built by Spacelabs, Inc., Van Nuys, Calif., under a fixed price contract awarded to it last week by National Aeronautics and Space Administration.

The NASA bid request indicated that the capability of transmitting physiological data was specified to satisfy requirements for obtaining such data from astronauts during early Apollo flights.

As specified by NASA, the system is to be capable of picking up with properly located sensors, processing and then transmitting such data as body temperature, respiration rate and depth, blood pressure, electrocardiogram, (two channels), electromiogram and electroencephalogram. A single voice channel will also be included in the system.

Three major assemblies composing the system will be a shoulder strap-supported belt pack transmitter package which can transmit the seven data channels by conventional FM/FM techniques; a belt-mounted voice transceiver and vehicle transceiver control station.

Apollo Timetable

The Apollo contract will call for an engineering mockup to be ready next August, nine months from the selection date. First boilerplate models will be flown late in 1963 aboard Saturn boosters built by NASA's Marshall Space Flight Center and the Chrysler-built boosters will begin to be used toward the end of the 10 to 12 flights that will carry Apollo through its test period and initial manned earth orbital flights.

North American's Space and Information Systems Division, formed last December from manned space flight personnel at the Los Angeles Division and unmanned space personnel at the Missile Division, will design and build Apollo at Downey, Calif. Project manager will be John Paup, who will be a vice-president. Harrison Storms heads the division.

North American will build two modules of the Apollo spacecraft—the crew section or "command center," and the component that will house fuel, electrical power supplies and propulsion units needed for lunar takeoff. The third module—the lunar landing system—will be awarded to a separate contractor within six months.

North American did not bid with team members, although it mentioned four or five companies that it would prefer as subcontractors. NASA reserves the right to select subcontractors other than those named by North American if it desires to, but if it actually did so this would be an exception to its general rule.

Martin Co. also bid alone. General Dynamics bid with Avco, General Electric bid with Douglas, Grumman and Space Technology Laboratories, and McDonnell Aircraft bid with Lockheed, Hughes and the Vought Astronautics Division.

North American's technical proposal was understood to resemble more closely than any other the NASA Ames Research Center concept shown to more than 1,000 industry representatives who attended Apollo briefings here last July (AW July 31, p. 29).

Because Apollo is the largest and the most important project NASA has undertaken, the agency notified prospective bidders that it would give considerable weight to proposed management structure and personnel and to the amount of resources that could be devoted to Apollo.

The Space and Systems Information Division's major projects at the moment are the USAF Hound Dog air-to-surface missile and the Saturn S-2 upper stage. Neither project is considered at a cru-

Research Projects

North American Aviation's research projects include an anti-missile missile, a Mach 10 manned vehicle, an advanced fighter-bomber and an advanced ballistic missile, according to the company. It also said Air Force is studying a proposal for an advanced Hound Dog.

The aerospace firm reported profits of $27,750,137, or $3.38 per share of capital stock, on sales of $1,262,333,263 for the year ending last Sept. 30—the highest sales in the company's history (AW Nov. 13, p. 27).

Net income before taxes was $56,650,137. The $27.8 million profit after taxes amounted to 2.2% of sales. Backlog of unfilled orders was $931 million, excluding an estimated $1.36 billion for orders negotiated as continuations of authorized programs, but not yet funded. Last year's profit was $23,394,548 on sales of $964,162,496.

Non-aircraft programs accounted for about 62% of total sales and about 65% of sales were under cost-plus-fixed-fee contracts, the company said. Sales by divisions were Autonetics, $410,147,961; Los Angeles, $377,667,486; Rocketdyne, $180,250,168; Columbus, $133,776,710; Space and Information Systems, $108,143,886; Atomics International, $52,347,052.

cial stage from manpower point of view.

The over-all Apollo project will be supervised for NASA by Brainerd Holmes, director of manned space flight, and the spacecraft portion will be managed by Robert R. Gilruth, director of NASA's Manned Spacecraft Center. North American has offices at Huntsville, Ala., where the early Saturn boosters are being built, and at Langley Field, Va., where the Spacecraft Center is now located. It is expected to establish an office soon at Houston, Tex., to which the Spacecraft Center will begin moving early next year.

The Apollo vehicles will go from Downey to Houston for environmental testing, astronaut training, etc. Although airlift was not an absolute requirement in the Apollo competition, NASA believes a slightly modified Douglas C-133 could carry the two modules that North American will build. They also can be moved to Houston by truck. Shipment from there to the launch site at Cape Canaveral, Fla., may be by ship. North American expects to move the Saturn S-2 stage by Navy landing ship-dock (LSD).

First Flight Tests

Some of the first flight tests will use simplified Apollo vehicles. NASA may build cruder models for drop tests, water impact studies, etc., but does not intend to build any of the flight vehicles. Current estimates on the total number of Apollos that will be flown for the three phases of the program—earth orbit, circumlunar and lunar landing—is not more than 20, but with the first test flight still two years away this is considered too preliminary to represent an upper limit.

Chimp Shot Raises Hope That U.S. Can Orbit Man Before Year's End

By Edward H. Kolcum

Cape Canaveral—Hopes for an orbital flight by a U. S. astronaut late this month were revived by the successful flight last week of a chimpanzee-carrying Project Mercury capsule on a two-orbit mission.

Mercury officials told AVIATION WEEK, however, that there is no pressure on them to attempt the manned flight before Dec. 31, and the manned mission will not be flown until its chances of success are assured.

Concerned by reports that there has been pressure from the Administration and National Aeronautics and Space Administration headquarters to get the U. S. manned flight on the record books this year, Walter C. Williams, associate director of NASA's Manned Spacecraft Center, said the Mercury team here "has been working a 168-hr. week for many months and we will continue this schedule."

Williams said the impression that the production people have been working at half speed and now must go into a crash program to accomplish manned orbital flight in the same year as Soviet Russia is a false one.

Prior to the chimpanzee flight, designated MA-5, the manned orbital flight was scheduled for Dec. 28, with the chance that it could be moved up a week if the chimp flight were flawless. NASA announced the flight teams (see box p. 28) for the first two orbital missions, but Robert R. Gilruth, director of the Manned Spacecraft Center, said this in no way commits NASA to a 1961 flight.

MA-5, scheduled to be a three-orbit mission, was launched at 10:07 a.m. EST Nov. 29 but was ended after two orbits because of malfunctions that NASA said could have been corrected by a human pilot. The Muchea, Australia, tracking station detected a failure in the roll reaction jet and an increase in cabin temperature during the second orbit. These conditions were confirmed by stations at Woomera, Australia, and in Hawaii.

Christopher C. Kraft, Mercury's flight director here, made the decision to end the mission. Retro-rockets were fired at 1:08 p.m. EST on ground command from the Pt. Arguello Station, Calif.

The capsule impacted at 1:28 p.m. EST 242.3 mi. due south of Bermuda and was retrieved at 2:53 p.m. EST by the radar picket destroyer USS Stormes.

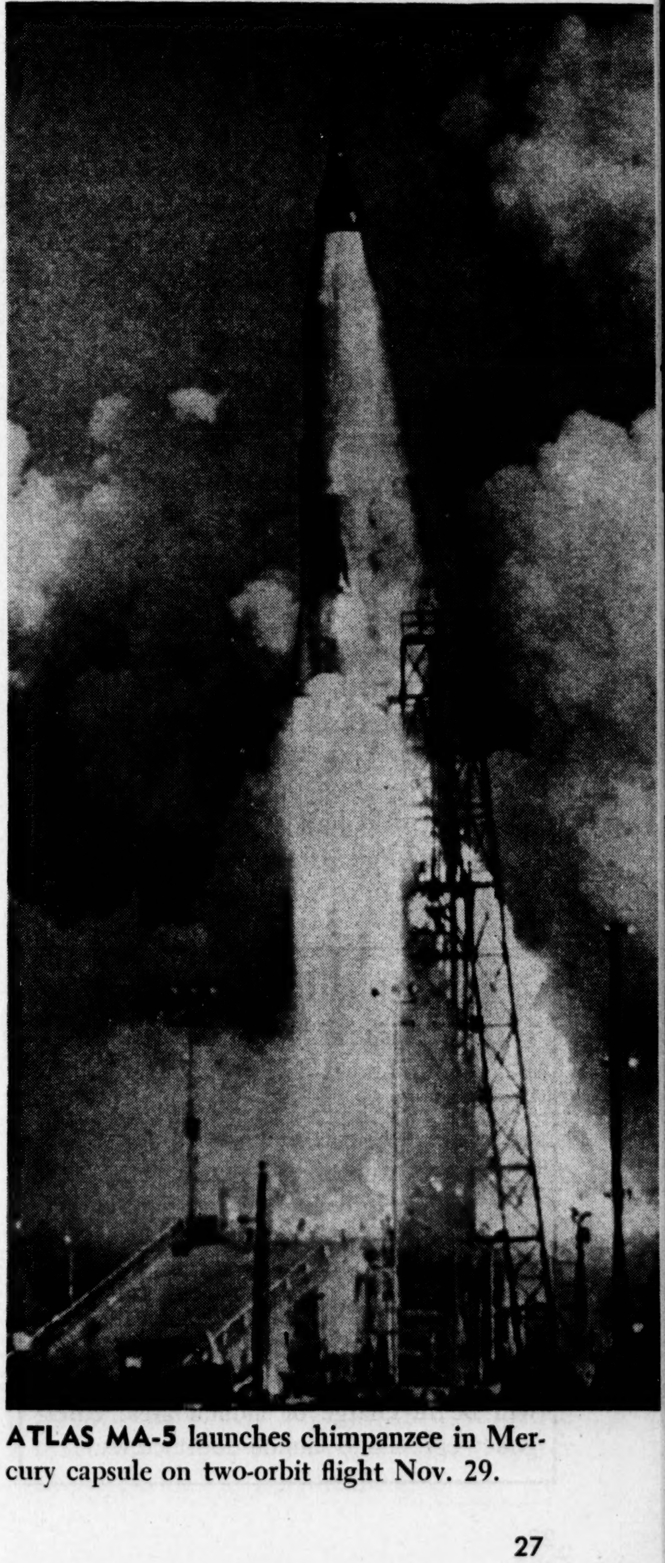
Preliminary data indicated that these conditions existed before the decision to end the mission after two orbits:

- **Roll reaction jet** did not respond to the automatic control system, either because the feed system stuck open or closed. The capsule had started to go into a roll displacement, which was observed by Muchea. A completely independent manual override would have been used by a pilot to correct this condition. A significant amount of hydrogen peroxide for the control jets had been expended, and rather than risk an improper retro-fire attitude, officials brought the capsule down while enough peroxide remained to orient it on the correct re-entry axis. An incorrect retrofire attitude could have pushed the capsule into an elliptical orbit.
- **Overheating of the capsule** was caused by a malfunction in the cooling system, which uses water vapor as a coolant. This condition was not as serious as that in the reaction motor and was beginning to correct itself when the decision was made to end the mission. It is believed that the water vapor froze and plugged the cooling orifices, which eventually unplugged themselves.

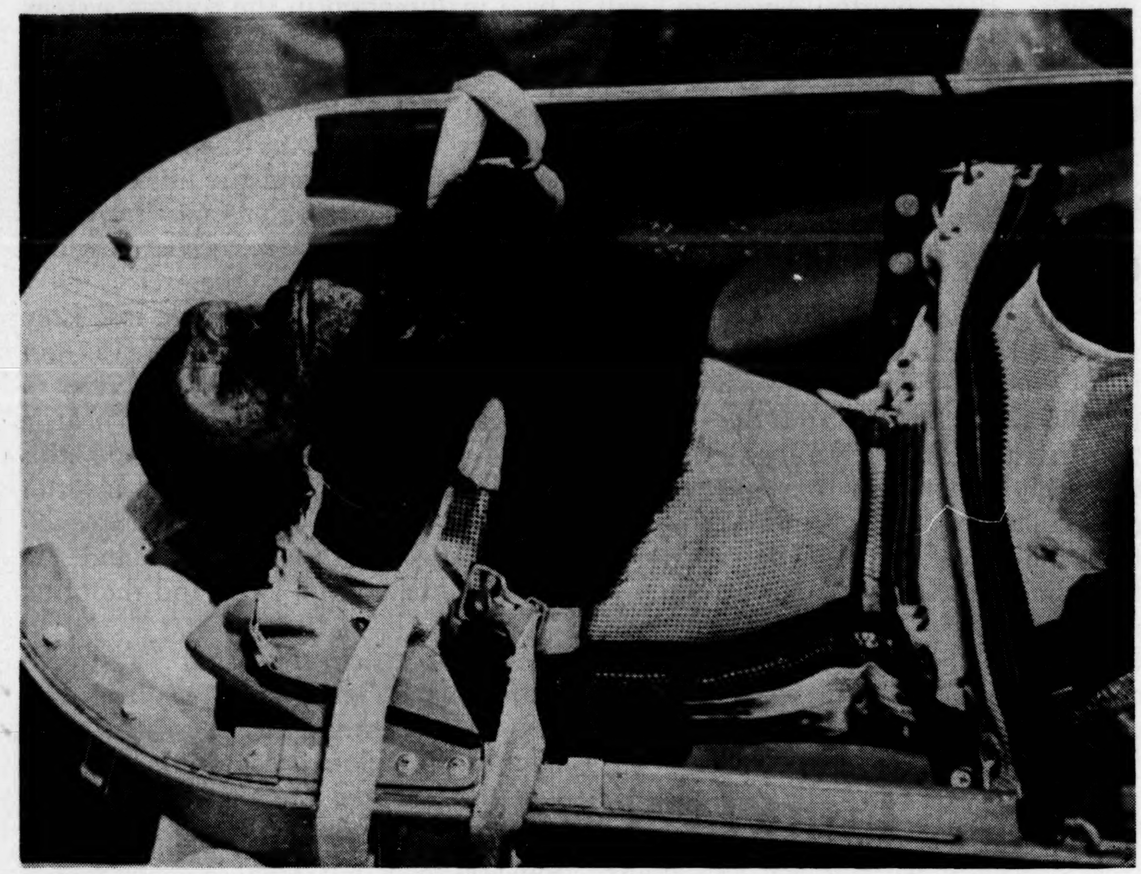
Temperature in the capsule rose from a 78F normal to 86F, which was not considered critical. Because inverters in the capsule radiate most of the heat, a human pilot would have solved this problem by putting a standby inverter on the line. The capsule has three inverters—two on the attitude and environmental control loops and the other in reserve.

Gilruth called the flight "a superb performance," and said very little data was lost by terminating the flight early. The most striking part of the mission was the way the tracking network was able to analyze data and act on it quickly.

The flight trajectory began flawlessly after several holds caused by loss of data



ATLAS MA-5 launches chimpanzee in Mercury capsule on two-orbit flight Nov. 29.



CHIMPANZEE is shown before MA-5 launch. His aluminum and plastic capsule was connected to Mercury capsule's environmental system loop.

and computer links between Goddard Space Flight Center in Washington, D. C., and several of the tracking stations.

The General Dynamics Atlas launch vehicle weighed 264,790 lb. at ignition. It followed the planned boost cycle with booster shutdown 131 sec. after ignition when it was at an altitude of 39 mi. and 52 mi. downrange and traveling at a velocity of 10,330 fps. The escape tower was jettisoned 154 sec. after launch and the sustainer and vernier engines shut down simultaneously at 304 sec. after launch. The capsule separated from the vehicle one second later and was injected into orbit at a velocity of 26,700 fps. Precision of the launch is indicated by the fact that injection velocity was within 5 fps. of that planned. The 10,400-lb. empty Atlas vehicle also went into orbit but was not tracked and was expected to re-enter after two or three orbits.

The capsule had a perigee of 99 mi., an apogee of 146 mi. and a period of 88.5 min. There was no damage to the pad, and B. G. MacNabb, General Dynamics general manager here, said it could be ready for the MA-6 launch vehicle at midnight Nov. 29. He said the MA-6 vehicle, Atlas 109D, was loaded on a Douglas C-133B at San Diego just after the chimpanzee was launched for immediate delivery to the Cape.

Orbit Pilots Chosen

Cape Canaveral—Marine Lt. Col. John H. Glenn and USAF Maj. Donald K. Slayton will be the primary pilots for the first two Project Mercury orbital flights.

Cdr. M. Scott Carpenter will be Col. Glenn's backup and Cdr. Walter M. Schirra will be the backup for Maj. Slayton. The first two U. S. astronauts, Cdr. Alan B. Shepard and USAF Capt. Virgil I. Grissom will be chief technical advisers. USAF Maj. L. Gordon Cooper will be in charge of launch area, emergency egress and launch abort crews.

Two Navy Douglas A3D aircraft photographed the capsule as it was boosted through the maximum dynamic pressure zone from 35,000 to 40,000 ft. altitude.

Objectives of the MA-5 flight were to provide precise mission tests for all launch vehicles, capsule and ground systems as a final qualification before manned orbital flight, with all components duplicates of those to be in the astronaut flight.

The male chimpanzee passenger, Enos, weighed 37.5 lb. It is 64 months old, and has been under training by the Air Force Systems Command at Holloman AFB, N. Mex., for the past 18 months. The chimp had a 69-min. work-rest cycle, repeated throughout the flight, designed to compare its ground performance with performance in space. These were its tasks:

- **Shock avoidance** by depressing a lever at the right side of his sealed cabin at least once every 20 sec. A red light appeared over the lever 120 sec. before launch, and remained lit for 15 min. On the ground, the chimp averaged 54 lever depressions each minute.
- **Reaction measurement,** by turning off a blue light to avoid shock. This task was done simultaneously with the red light test and was designed to determine the speed with which the chimp could turn off the light. The blue light, at the left side of the cabin, lit for five seconds every two minutes. Ground reaction time for the chimpanzee was one second.
- **Rest period** for six minutes, with no tasks.
- **Differential reinforcement,** to determine thirst in space. Enos, on a low water diet before launch, was trained to suck a nipple when a green light glowed above it. This test lasted 12 min., and the chimp could obtain 20 drinks of water during this period.
- **Six-minute** rest period.
- **Reward task,** in which the chimp received a banana pellet for depressing a lever identified by a yellow light. Every time the animal hit the lever 50 times, a pellet was ejected between two rubber fingers. During ground tests Enos normally received 12-20 pellets during the 12-minute task.
- **Rest period** for six minutes.
- **Negative odd set task,** in which 18 different patterns were flashed above the levers during a 12-min. cycle, each with an odd symbol. In order to avoid a shock, the chimp had to eliminate the odd symbol. Enos' ground score had averaged 58-72% accuracy.

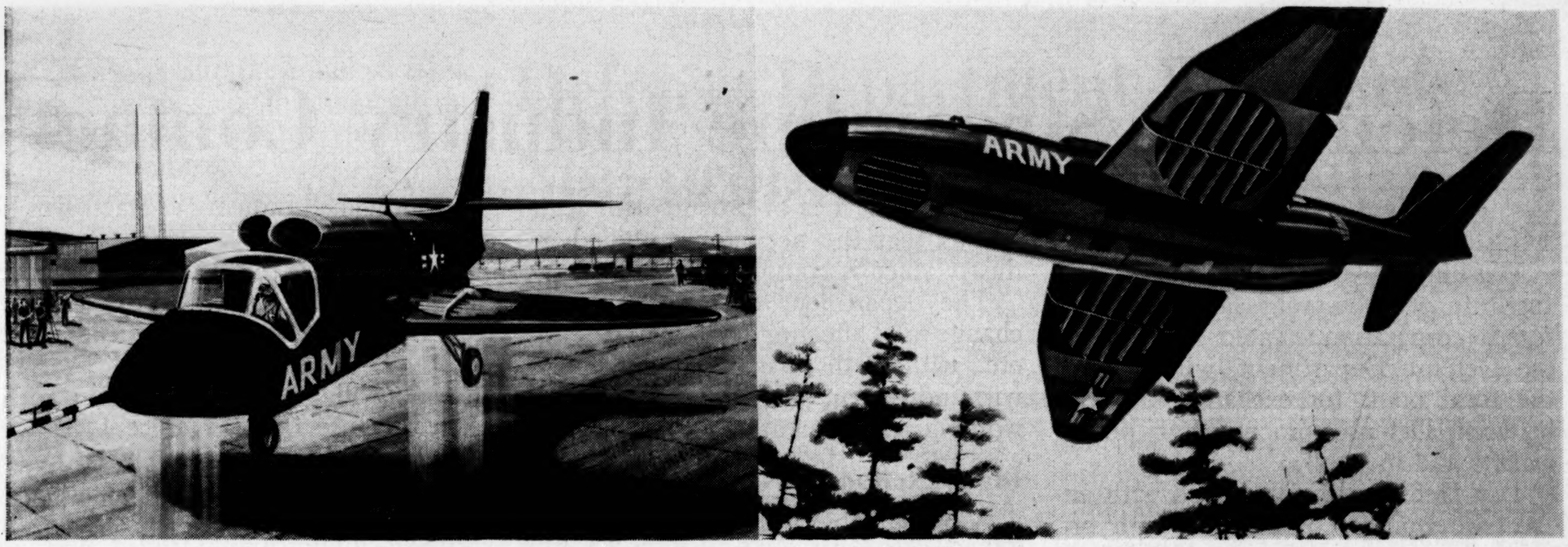
The chimpanzee was housed in an aluminum and plastic capsule which was connected to the environmental system loop. NASA said that it has corrected the fault which caused an abnormally high oxygen consumption during the MA-4 flight (AW Sept. 18, p. 32). Launch vibration in MA-4 caused the emergency oxygen manual handle to move to the open position.

The capsule carried three 16 mm. cameras and one 70 mm. camera to photograph the chimpanzee, the instrument panel, the view through the periscope, and the view through the capsule window. Four radiation emulsion packs also were carried, two of them to measure total dosage, and two designed to determine initial energy and type.

There were 78 heat sensors in the capsule, but NASA said noise and vibration was not sampled because previous tests have indicated they were not sufficient to cause difficulty.

MA-5 mission was the first designed to test the 18-station Mercury tracking and communications network. The $75-million network was completed by Western Electric Co., prime network contractor, July 31. Data from the stations was sent by the network to NASA's Goddard Space Flight Center IBM 7090 computers, interpreted and relayed instantaneously to the Mercury control center here.

In the recovery area, a crew from Avco Corp. monitored re-entry with cameras and spectrographs while flying in a USAF aircraft. This technique was necessary because the plasma sheath which surrounds the re-entry vehicle prevents telemetry transmission.



Ryan to Build Fan-in-Wing Aircraft

Two fan-in-wing research aircraft will be designed and built for Army's VTOL lift-fan program by Ryan Aeronautical Co. under subcontract to General Electric Co. Shown here in artists' conceptions, the research vehicles will be used to evaluate flight characteristics of the lift-fan system in hover and transition, and to demonstrate high-subsonic-speed flight. Design maximum speed will be 450 kt. First flight date is scheduled for May, 1963. Phase I contract for $6.9 million, covering one complete airplane plus propulsion and airframe for a second, was awarded to GE last month by Army's Transportation Research Command. About half of that sum will go to Ryan for airframe development and construction. Total contract cost will be $10.5 million and will cover 24-month program. Air Force will contribute by furnishing the GE J85 engines and diverter valves which supply power to the six-foot diameter turbine-driven lift fans. GE asked for proposals on the research aircraft in a competition which Ryan won with this concept. Ryan's work will include further detail design and construction of the airframe.

UN Space Group's Usefulness in Doubt

United Nations—Committee on the Peaceful Uses of Outer Space, the instrument through which the United Nations hopes to establish international cooperation and harmony in space exploration, appears to be headed for an extended lifetime but uncertain usefulness as the Soviet Union insists on the right to effectively veto any committee proposal.

The 24-nation committee met last week for the first time since its establishment by the General Assembly in December, 1959 and elected Dr. Franz Matsch, Austria, as its chairman; Prof. Mihail Haseganu, Romania, as vice-chairman and Geraldo de Carvalho Silos, Brazil, as recording secretary. It heard statements from a number of the representatives and then adopted a report—which simply contained the names of the elected officers, the nations in attendance and a reference to the verbatim record of the representatives' statements—to be forwarded to the Political and Security Committee, to which it reports.

This committee is expected to pass the matter on to the General Assembly soon. UN observers believe that a vote will be taken, extending the mandate of the Committee on the Peaceful Uses of Outer Space beyond its present Dec. 31, 1961 expiration date.

Primary reason for the committee's failure to meet for the past two years has been the reluctance of the U. S. and the Soviet Union to accept each other's proposed procedural rules. The U. S. has suggested that the committee operate along the same general lines of other similar UN groups, with decisions reached by a majority vote.

Valerian A. Zorin, Soviet permanent representative to the UN, reminded the committee of Sputnik 1 and the flights of Yuri Gagarin and Gherman Titov and said that "the Soviet Union attaches the greatest importance to the development of international cooperation in the important field of outer space exploration."

The Soviet delegate said that the USSR was in favor of such cooperation but that "it must be emphasized that effective international cooperation in efforts to penetrate outer space can be developed only on the condition that it is carried out on the basis of the genuine equality of states.

"If anyone attempted to use the noble idea of cooperation," he cautioned, "in the narrow interests of a particular group of countries, then of course it would not be possible even to speak of effective cooperation and it may be said beforehand that, in such an event, the work of the Committee on the Peaceful Uses of Outer Space would fail."

To assure "genuine equality of states," Zorin suggested that all committee decisions be reached by unanimity "because it is only in this manner that the possibility could be eliminated of the adoption of decisions by a mechanical majority of votes in the interests of this or that closed group of states."

Charles W. Yost, U. S. deputy permanent representative to the UN, later told Aviation Week that the Soviet demand for "unanimity" was tantamount to veto power over the committee's operation and that the U. S. could not accede to it. Yost also said that he believed that the committee's mandate would be renewed and that the committee's membership probably would be expanded to include some African nations.

During the committee's $1\frac{1}{2}$-hr. session, Yost said that there are four "initial measures" which the UN General Assembly should take immediately to "preserve peace in outer space and extend to all nations the benefits of exploring it:"

- **Acknowledgment** that international law and the UN charter extend to the limits of space exploration and recognition that outer space and celestial bodies are not subject to national appropriation by claim of sovereignty.
- **Registration of all space vehicles,** with the UN's Secretary General maintaining a central record of "space launch data."
- **International sharing** of the benefits derived from space technology, with particular reference to meteorology. The U. S. recommended that the World Meteorological Organization undertake "measures to advance the state of atmospheric science and technology and to develop existing weather forecasting abilities and help member states make effective use of these through regional meteorological centers."
- **Development of communications** satellites, on a global and nondiscriminatory basis, to expand and improve international communications and foster international understanding.

Defense to Streamline Industry Contacts

By Larry Booda

Washington—Logistics Management Institute, the non-profit, fact-finding research corporation created recently by the Defense Department, will become the focal point for exchange of ideas between Defense procurement policy makers and industry.

Top Defense officials, faced with an excessive number of contests with organizations representing a wide variety of industries, will try this approach in an attempt to reduce duplication.

They are anxious to streamline the communications process without leaving the impression that the department or the Administration is anti-business.

On the other side, industry itself has become increasingly perplexed on how best to have its points of view presented to Defense officials. Many large companies have diversified their defense business and have joined a variety of trade associations (see box). They sometimes find themselves being represented by several groups with varying ideas.

These industry organizations and others representing professions or special interest groups compete for the time and attention of Defense civilian and military officials, who find themselves working long hours and then having to spend evenings fulfilling speaking engagements or otherwise taking part in industry-sponsored meetings.

It is in the area of procurement regulations that the need for a unified industry voice is considered greatest.

The department does not want to change rules affecting contracts, patents, etc., without discussing them at length with industry in order to avoid awkward working arrangements.

Idea Exchange Needed

A prime subject is that of contracts. The fixed-price type of contract is being supplanted to a great extent by cost-plus-fixed-fee and incentive contracts (AW Nov. 20, p. 26). To protect the interests of the government, an exchange of ideas is necessary to assure that rules governing contract machinery provide for economy in development and production without imposing an intolerable set of controls on either government and industry that would themselves be uneconomical.

One official said the industry associations should be told: "You people get together. Form a composite group to discuss specific matters, ready on call." He said this would be a form of ad hoc committee.

This approach was used recently for the first time in a private meeting with eight representatives of associations. They were told that if they could get together and speak with one voice they would have more opportunities to talk to Defense officials. They also were told that individual industry contacts will be discouraged.

In choosing the Logistics Management Institute as the principal initial contact point for industry, consideration was given to the point that the LMI officials will have more time to listen than Defense officials, since LMI will spend full time on procurement policy matters. It will follow policy guidelines laid down by Defense in listening to industry and recommending changes.

LMI is just beginning to build an organization under Dr. Sterling Livingston, who is on leave from Harvard University as interim president until Jan. 1. It will concentrate on what to buy, how much to buy and how to buy most economically and efficiently.

For its first year LMI has been awarded a $600,000 contract (AW Nov. 27, p. 28) to focus its efforts in the following areas:

- **Requirements planning.** Emphasis will be on developing a system for rapid determination of procurement objectives, analysis of assets, evaluation of readiness, ways to reduce the initial procurement of spares and repair parts, means of cutting variety and cost of engineering and technical data acquired, and seeking methods by which the effect of incremental funding on cost and performance can be determined.
- **Specifications, standards and designs.** This will involve a program to eliminate

Groups With Varied Interests Deal With Pentagon

Groups which deal regularly with the Defense Department and the military services fall into three general categories—professional societies whose members are engineers, scientists or educators; trade and industry associations; and organizations with individual members whose interests are identified with the military services, such as the Air Force Assn., the Navy League and the Assn. of the U. S. Army. They include:

Aerospace Industries Assn. of America
Air Force Assn.
Air Transport Assn. of America
American Assn. for the Advancement of Science
American Chemical Society
American Institute of Biological Sciences
American Institute of Chemical Engineers
American Institute of Electrical Engineers
American Meteorological Society
American Ordnance Assn.
American Physical Society
American Rocket Society
American Society of Civil Engineers
American Society of Engineering Education
American Society of Mechanical Engineers
Armed Forces Chemical Assn.
Armed Forces Communications and Electronics Assn.
Armed Forces Management Assn.
Assn. of Missile and Rocket Industries
Assn. of American Railroads
Assn. of Local Transport Airlines
Assn. of the United States Army
Chamber of Commerce of the USA
Defense Orientation Conference Assn.
Electronic Industries Assn.
Independent Air Carrier Assn.
Institute of the Aerospace Sciences, Inc.
Institute of Radio Engineers
Independent Airlines Assn.
Joint Industry Contract Committee
National Assn. of Manufacturers
National Assn. of Professional Engineers
National Aviation Trades Assn.
National Federation of Independent Business, Inc.
National Security Industrial Assn.
National Small Businessmen's Assn.
Navy League of the United States
Quartermaster Assn. Inc.
Reserve Officers Assn.
Retired Officers Assn.
Society of American Military Engineers
Transportation Assn. of America

unnecessary specifications and excessive quality standards, and recommend improved methods to control engineering and design changes.

- **Competition in defense buying.** Ways will be studied to increase competition in the purchase of production quantities of new equipment, components and parts.
- **Reducing cost of procurement** practices. This will include appraisals of problems involving evaluation of contractor qualifications, reducing proposal costs, improving spare parts pricing, simplifying purchasing procedures and awarding a fair proportion of defense contracts to small business.
- **Control of contractor** performance. A system will be developed to evaluate status of schedules, costs and technical performance and exploring a means of making more effective use of contract incentives.
- **Strengthening administrative** and personnel practices. Propose action plans for selecting and training top logistics personnel, establishing uniform contract administration procedures and reviewing procurement operations by contracting personnel.

Secretary of Defense Robert S. McNamara said recently that he felt "creation of the institute will serve an important function of bringing to bear on the complex problems of defense logistics the most experienced, capable and creative business management. While our top civilian and military logistics staffs are manned by capable people, these men are so occupied with critical day-to-day operations that they are unable to devote uninterrupted time to the detailed studies and analyses which are required."

He said the institute will have a working level staff of 10 to 15 senior men with broad consulting and research experience in procurement and logistics. Some studies will be subcontracted to universities and private consulting firms when specialized talents are required.

Defense officials also are concerned over requests from professional societies and other special interest organizations for participation in meetings. In many instances the purposes and interests of groups overlap or are identical.

Two large organizations often mentioned as examples are the Institute of the Aerospace Sciences and the American Rocket Society.

A move was made last year toward a merger of these two associations but it failed. They and other organizations will be subjected to subtle pressure to hold joint meetings or to merge, through selective acceptance by Defense officials of speaking engagements and by control of professional papers.

No centralized effort has yet been ordered, but high officials are encouraging these ideas.

Defense Department Will Unify Non-profit Organization Policy

Washington—Defense Department will cut across service lines and develop a coordinated policy for dealing with non-profit organizations engaged in military research.

Roswell L. Gilpatric, deputy secretary of defense, said his special assistant, Adam Yarmolinsky, will coordinate the effort. Gilpatric said he was "concerned with the need to relate these diverse activities" of the various military departments in the non-profit field (AW Oct. 30, p. 26).

Currently, the Defense Department's general counsel, research and engineering office, Logistics Management Institute and the individual service secretaries all are trying to develop policies for dealing with non-profit organizations. The Budget Bureau is also conducting a broad study in the same field for President Kennedy. The Budget Bureau was to submit its report by Dec. 1, but a spokesman said the deadline will not be met.

Air Force Secretary Eugene M. Zuckert Sept. 22 issued a policy statement for Air Force dealing with its non-profit corporations—Aerospace, Analytic Services, Mitre, Rand and System Development. Statement is the first issued since the House appropriations committee ordered such policy guidelines in its report this year on the Defense Department's Fiscal 1962 budget.

"The practice of governmental agencies contracting with various corporations and organizations for technical management, scientific evaluations and administrative and management services is increasing at a rapid rate," the committee report said. "The government is moving toward a chaotic condition in its personnel management because of this practice."

High Pay Scored

The committee expressed dismay at the high salaries paid personnel at non-profit corporations doing work for the Defense Department, and said it would have limited salaries except "it was felt that such drastic action would bring about delays in vital military programs now under way and create further confusion rather than eliminate it." The committee said it would impose such limitations, however, unless the Secretary of Defense established a realistic policy for dealing with non-profit corporations by the time Fiscal 1963 budget estimates were made to Congress.

Zuckert's statement said "salaries pose perhaps the most difficult problem of all." It said Air Force non-profit corporations' employment policies "must be marked by good judgment and restraint. These companies have no license to outbid the market at every turn. If the compensation paid by these non-profit corporations exceeds that paid by the government, it should be because private industry typically offers such higher compensation."

Zuckert's statement was designed to establish guidelines for dealing with Air Force corporations, not to provide a detailed directive. "Standardization should be the rule," the statement said, "down to such particulars as contract clauses. Exceptions must be firmly founded in fact."

Purpose of the non-profit corporations, Zuckert said, "is to focus the nation's finest scientific and technical talents on selected and highly sophisticated tasks. They must not become convenient catch-alls for projects which could be performed by private industry. The elite nature of their technical staffs must be preserved . . . frills and other non-essentials cannot be tolerated if public confidence is to be maintained in their unique role."

The House Armed Services' Special Investigations Subcommittee next year plans to probe Defense contracts with non-profit corporations. One concern of the subcommittee is whether employes of such corporations use inside military information to make money on the stock market.

Zuckert touched on this in his directive by declaring "there must be no conflict between the public interests with which these non-profit corporations are impressed and the private interests of their trustees, officers, members of technical staffs and other employes. Each corporation will be expected to prescribe and enforce suitable regulations to this end."

Zuckert said non-profit organizations deserve special treatment when it comes to awarding them fees. Since these corporations do not have profits like commercial companies to plow back into research programs, Zuckert said that fees could be employed to enable non-profit corporations to pursue research beyond that covered in the Air Force contract. Such fees also could be used to provide non-profit corporations with working capital, Zuckert said. However, he warned that fees "should not be regarded as a substitute for advance payment arrangements, the preferable sources."

Air Force should direct disposal of non-profit corporations' assets upon dissolution, the statement said. It asked corporation boards to provide for this.

U.S. Will Outline Impact of Arms Control

By Katherine Johnsen

Washington—Opportunities for social and economic advancement that would be opened through general disarmament, both within the U. S. and worldwide, will be outlined in the first comprehensive U. S. government evaluation of the impact of arms reductions to be submitted to the United Nations Dec. 15.

The report will note the disruptive effect of shifting resources from military to non-military production, but this problem will be minimized as temporary.

Administration economists point out that the military segment approximates only 9% of the nation's $526 billion annual gross national product.

According to U. S. estimates, the dollar value of the Soviet Union's military outlay approximates that of the U. S., but represents some 20% of the Soviet economy.

The U. S. report was requested by the UN Secretariat, directed under a resolution of the UN General Assembly to make a world-wide study of the social and economic impact of general and complete disarmament.

The Secretariat, which has estimated world armament expenditures at $320 million a day, or $116.8 billion a year, appointed a ten-member Consultative Group to handle the study. The U. S. is represented on the group by Wassily Leontiff, professor of economics at Harvard University, the Soviet Union by V. Y. Aboltin, deputy director, Institute of World Economics and International Relations, USSR Academy of Sciences. Other members are from Great Britain, France, Czechoslovakia, Poland, Pakistan, Venezuela, India and Sudan.

British Financial Aid

London—British government will furnish financial support to existing aircraft industry projects at least on the present level of about $20 million a year, Minister of Aviation Peter Thorneycroft told Parliament last week.

He emphasized the support has been given, or will be given to the Vickers VC.10 (Royal Air Force has ordered five), the BAC 111 medium-range jet transport, the Westland Rotodyne VTOL transport, de Havilland Trident jet transport, and the Rolls-Royce Spey turbojet engine.

Thorneycroft said other projects are under consideration, probably a reference to a potential RAF order for a batch of de Havilland DH-125 executive jet transports. He added: "We try to put in money only where the industry is putting in money."

At its first meeting in Geneva in August, the group drew up its request for detailed information and submitted it to UN member nations. The information is to be based on the assumption of "complete and general disarmament under effective international control," which has been accepted as the goal of the UN under a General Assembly resolution.

The group is to start its evaluation of the submissions in January. The requests for information covers these areas:

- **Assessment of the release** of resources now supporting military demands—manpower, primary materials, productive capacity and imports.
- **Choice of uses** for released resources—expansion of productive capacity; more educational, scientific, and cultural facilities; increased social services, expansion of aid to under-developed countries.
- **Problems of conversion** of resources to non-military activities—retraining and absorption of personnel; conversion, expansion, and contraction of productive capacities; reorientation of research and technology; changes in regional specializations within the country.
- **Impact on international** economic relations and assistance for under-developed nations.

The U. S. report is being coordinated and drafted by the State Department's Office of International Organization Affairs and the two-month-old Arms Control and Disarmament Agency, which is still primarily in the staffing and organization stage. Specialized reports are being submitted by almost every department of government.

Meanwhile, U. S. Ambassador Adlai Stevenson and Soviet Deputy Foreign Minister Valerian Zorin, under heavy pressure from other UN member nations, last week resumed talks on the composition of a committee to draft a disarmament treaty—the immediate stumbling block.

The renewal of U.S.-Soviet discussions followed by one week a General Assembly resolution, approved by acclamation, urging this action and asking the two major powers to report on the outcome before the end of the session, scheduled Dec. 20.

These are the key points in the Sept. 20 U.S.-USSR statement of agreed principles which the drafting committee would implement:

- **The goal is a program** "which will ensure that disarmament is general and complete and war is no longer an instrument for settling international problems . . . and the program . . . shall ensure that States will have at their disposal only those non-nuclear armaments, forces, facilities and establishments as are agreed to be necessary to maintain internal order and protect the personal security of citizens. . . ."
- **"All disarmament measures** should be implemented from beginning to end under such strict and effective international control as would provide firm assurances that all parties are honoring their obligations. . . ."

The agreement on principles—although hailed by both the U. S. and the USSR as a major development—has not solved the fundamental difference in approach:

- **The U. S. wants** a cautious step-by-step control of arms—starting with a ban on nuclear testing. U. S. officials view complete disarmament as a twenty-year persistent effort. They point out that as long as relative military power is controlled and kept in balance, some undetected violations may not involve great risk—and probably less risk of all-out war than an unrestrained arms race. In a completely disarmed world, they note, a few undetected nuclear weapons and delivery systems could be decisive.
- **The Soviet Union wants** quick disarmament, including the prompt destruction of existing weapons. In discussions, USSR officials have mentioned a period of four or five years to achieve general disarmament. If their program for short-term scrapping of military power is accepted, the USSR has stated repeatedly it will "accept any control

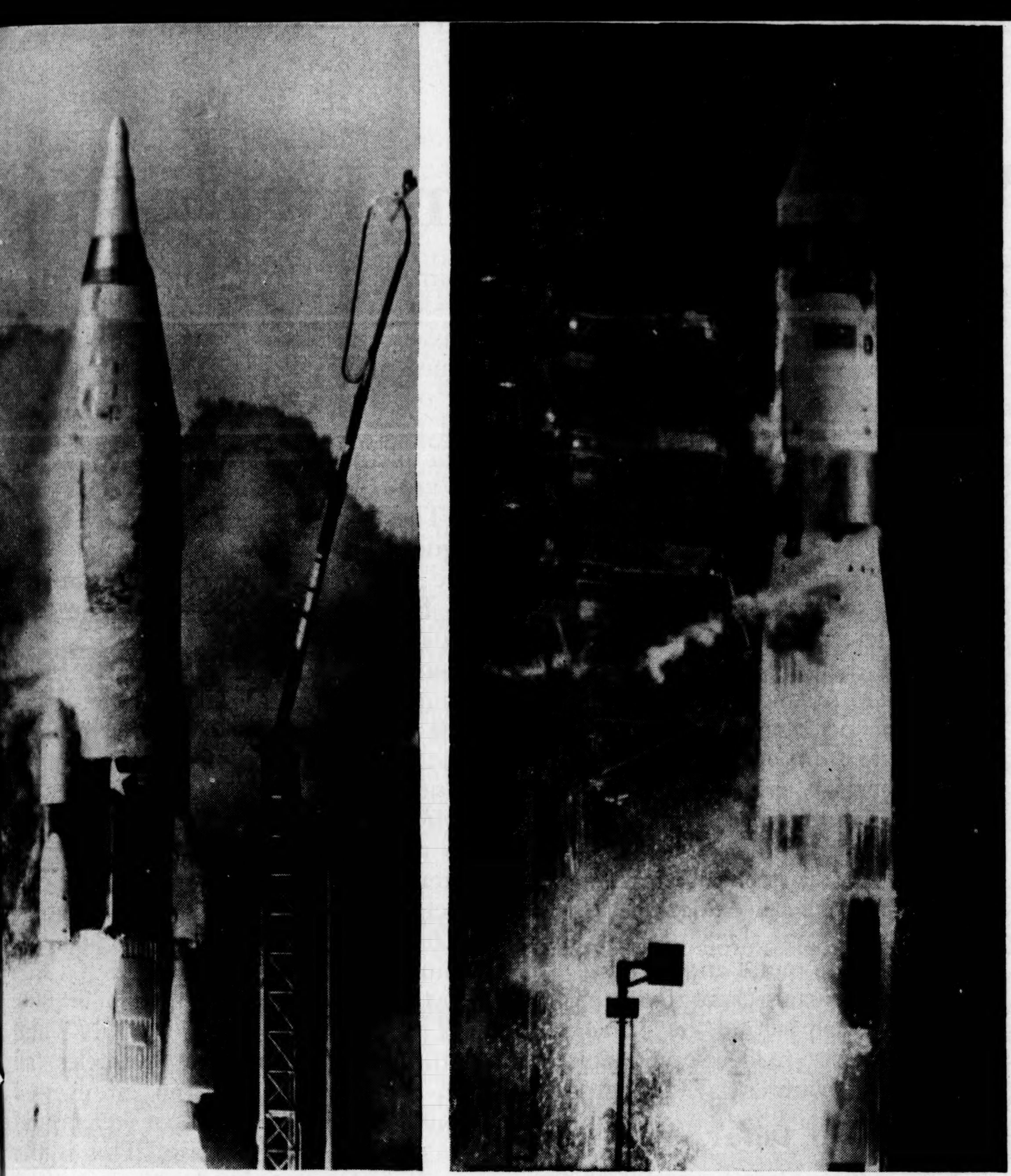
Convertiplane Records

Moscow—Soviet Union claims the convertiplane designed by Nikolai Kamov has set six world records. The vehicle (AW July 17, p. 31) recently lifted a payload of 33,069 lb. to a height of 8,390 ft.

The Soviets claim no helicopter has taken such a payload to a height exceeding 6,562 ft. (2,000 meters). This flight broke records for lifting a maximum load to an altitude exceeding 6,562 ft., by lifting loads of 1, 2, 5, 10 and 15 tons. The record flight lasted 30 min.

Previous record for maximum load lifted by a helicopter to 2,000 meters or more was set Sept. 23 (AW Oct. 2, p. 32) by the Soviet Union's Mil flying crane which lifted a payload of 33,302.12 lb. to 7,218.2 ft.

Data on the convertiplane flight is to be forwarded to Federation Aeronautique Internationale for recording. The next test for the convertiplane will be distance flying.



Titan, Atlas Carry Varying Payloads

Titan (right), launched Nov. 21 by an all-USAF crew from the 6555th Aerospace Test Wing, Patrick AFB, Fla., flew 5,000 mi. down the Atlantic Missile Range with an experimental target nose cone. Scheduled to be flown aboard Atlas missiles in next year's tests of the Army's Nike Zeus anti-ICBM system in the Pacific, at least one more target cone—built by General Electric—will be flown aboard a Martin Co. Titan from Cape Canaveral, Fla. Atlas (left), carrying an Avco Corp. Mk. 5 Minuteman re-entry vehicle, was launched from Cape Canaveral Nov. 22 with two pods attached to the airframe. Upper pod, made by Martin Co.'s Nuclear Division, and weighing 500 lb., contained 32 simulated atomic fuel cores (AW Aug. 7, p. 35) to test disintegration of nuclear devices during re-entry. Purpose of the bottom pod was not disclosed by USAF, but identified only as a "classified Air Force Special Weapons Center project."

proposed by the Western powers."

Stevenson has interpreted the Soviet offer for unlimited inspection as meaning only verification of armament destruction—not verification of armaments being maintained or produced. "No matter how many weapons were destroyed, it would be the weapons which were left that would be utilized in a military operation," Stevenson said in a UN speech.

Jet for Kennedy

Washington—Air Force will buy one commercial type Boeing 707-320B turbofan jet aircraft for President Kennedy's use.

The Defense Department announcement said the aircraft was selected "because of its combination of great range and payloads." Delivery date and exact price have not been determined.

Boeing 707-320B has a range of 6,670 miles and cruises at 610 mph. Commercial versions of the aircraft carry from 108 to 186 passengers or 20,000 pounds of cargo.

Congressional Comment

Sen. Joseph Clark (D.-Pa.) and others have urged that the U. S. "put the Soviet Union to the test" on their offer for any Western inspection system and "call their bluff, if bluff it is."

In opposing inspection under "arms control," the USSR contends that it would amount to legalizing spying in a world still heavily armed and with nations still capable of aggression.

In addition to the agreement on principles, the UN drafting committee will have programs proposed by the U. S. and the USSR for guidance. Each program is paced in three stages. Following is a comparison of the key recommendations for the first phase:

- **Strategic nuclear delivery vehicles.** All such means would be destroyed and their manufacture discontinued under the USSR proposal. Under the U. S. program, strategic delivery systems would be reduced gradually, and production and testing would be limited or halted. Complete elimination would not be accomplished until final stage of disarmament.

The USSR has protested that the U. S. proposal would weaken the main Soviet offensive arm—long-range rockets—but leave intact U. S. nuclear delivery systems stationed in bases circling the USSR.

- **Military bases.** The USSR would eliminate all foreign military facilities of any kind at the outset, while the U. S. makes no provision for the dismantling or conversion to peaceful uses of military installations until the second or middle phase of disarmament.
- **Force levels.** The military forces of the U. S. and USSR would be reduced to 1.7 million men each under the Soviet proposal; to 2.1 million men each under the U. S. proposal.
- **Conventional weapons.** Armaments of "prescribed types" would be gradually reduced and their production limited under the U. S. program. Weapons and munitions released by the reduction in the armed forces would be destroyed and military expenditures reduced during the first phase, under the USSR program. Further reduction in conventional forces would occur in the second stage.
- **Outer space.** States would be required to give advance notification of launchings of space vehicles and missiles, together with the track of the vehicle, under the U. S. program. The USSR program would require that launchings be accompanied by verification, including inspection at rocket sites.

World Speed Record Is Claimed by Navy

Washington—Navy claimed a world speed record Nov. 22 when USMC Lt. Col. Robert B. Robinson flew an F4H Phantom II jet aircraft 1,606.342 mph. over Edwards AFB at an altitude of about 45,000 ft.

The existing jet aircraft speed record is held by USAF Maj. Joseph W. Rogers, who flew an Air Force F-106 1,525.96 mph. Feb. 15, 1959. Data on Col. Robinson's flight has been submitted to the Federation Aeronautique Internationale in Paris for certification as a world record.

The Navy said the 1,606.342 mph. average speed was achieved over a 20-mile course. Maximum speed during the speed run was 1,650 mph., the Navy said.

Air Cushion Vehicle Program Increasing

By George C. Wilson

Washington—U. S. government interest in air cushion vehicles reached a new high last week when the Navy announced it had awarded a $2,040,000 contract to Bell Aerosystems Co. to design and build a 20-ton craft for over-water use.

The Navy Bureau of Ships' cost-plus-fixed-fee contract represents the biggest dollar investment the U. S. government has made to date in any one air cushion vehicle. The $2,040,000 contract compares with the $2,773,000 all three military services were authorized to spend in this field in Fiscal 1962.

Work on the Navy vehicle, called a "hydroskimmer research craft" rather than a ground effect machine (GEM), commences at a time when top U. S. Defense officials are reviewing the whole GEM program and the British are preparing to test the 27-ton Saunders-Roe N-2 hovercraft Results of next year's tests of the SR N-2 will significantly influence U. S. policy in regards to GEMs.

In addition, the House Science and Astronautics Committee is laying the ground work for hearings in February on the U. S. effort in the GEM field. Chairman George P. Miller (D.-Calif.) is much impressed with the British work in hovercraft and wants to find out through public hearings whether the U. S. program is adequate.

Dr. Marvin Stern, deputy director of weapons systems in the Defense Department's Research and Engineering Office, is the over-all head of the military's GEM program. He told AVIATION WEEK he personally would review the GEM effort to determine if it is receiving enough emphasis.

Many Army and Navy officials working directly in the GEM field complain the program is technologically sound but has yet to receive adequate support at high Defense Department levels. Without more moral and financial support, these officials claim, the U. S. will continue to lag behind the British, and perhaps Russia, in developing practical military and commercial GEMs.

Fundamental Data

T. C. Muse, Stern's director of aeronautics who has been evaluating the GEM programs of the various services, said until now there has not been sufficient "fundamental data to see how these things [GEMs] would really work" He said the real potential of GEMs had to be sifted from wild claims. "I don't feel the GEM program has been downgraded, and certainly not intentionally," Muse said.

On the basis of present information, Muse said, GEMs will be more useful over water than over land, where rough terrain limits their operation. The ultimate vehicle he envisions would be about 200 ft. in diameter, weigh about 100 tons and be able to beach itself. The U. S. Army Transportation Research Command sees much broader uses for GEMs, including a large vehicle which could carry its own weight in troops or equipment over rough terrain.

Both Muse and Dr. Eugene G. Fubini, the Defense Department's deputy director of research, said "the jury is still out" as far as the GEM program is concerned. They feel the program should be continued at about its present level for now, but added that future GEM progress may change their minds. Muse said the British experience with the SR N-2 will be an important indication of the worth of such large air cushion vehicles.

The SR N-2 is 60 ft. 3 in. long, 29 ft. 6 in. wide and is powered by four Blackburn A.129 free-turbine engines. It is designed to carry between 54 and 66 passengers or 100 standing soldiers, cruise at 70 kt. at a height of 1 to 1½ ft. off the surface of the water. Its typical operational weight will be 27 tons (for picture of SR N-2, see AVIATION WEEK, Oct. 3, p. 87).

The Navy's new vehicle will be designed for the same cruising speed as the SR N-2 and will be approximately 26 ft. by 62 ft. Power will come from four Solar Saturn 1,100-hp. gas turbine engines. The vehicle, expected to be completed in mid-1963, will be the biggest of its type owned by the military. The Maritime Administration currently is negotiating a contract with the Vehicle Research Corp. of Pasadena, Calif., for a large over-water GEM. Douglas Aircraft Co. will be the major subcontractor. Maritime Administration hopes to have a 50-ton vehicle designed and a model of it tested by the end of 1962. Cost is expected to be about $370,000.

The Navy hydroskimmer, SR N-2 and Maritime Administration vehicles all will derive their lift from air exerted upon the surface by a ring of jets around the perimeter of the base. This is the annular jet principle. Another method for getting lift is to use an open chamber, rather than rely on a curtain of air around the perimeter of the vehicle. The open, or plenum, chamber is shaped something like an upside down bathtub. Some GEMs use two sets of propellers, one set to pull in air for lift underneath and another to serve like airplane propellers to propel the vehicle forward.

Large GEMs have special advantages over small ones. They have more stability since they ride a bigger air cushion, are able to hover at greater heights and have more lift. The practical hover height is about 5% of the width of the vehicle's equivalent diameter. As for lift, doubling the diameter of the vehicle, but not changing the power, multiplies the lifting force of the vehicle by four.

Some GEMs are shaped like an air-

Executives Resign

Two more top General Dynamics Corp. executives left the company last week, adding themselves to a list of officials who left the firm shortly before and following a major reorganization of the aerospace firm (AW May 8, p. 45).

C. Rhoades MacBride, executive vice president in charge of General Dynamics' four western divisions, submitted his resignation while on vacation. He had been with the company since 1958 and previously was president of the Convair Division, which was split into four separate divisions under the reorganization.

Robert C. Loomis, president of General Dynamics/Convair at San Diego, Calif., left Convair to become president of American Electronics, Inc. at Los Angeles.

A General Dynamics spokesman said that Loomis had recently moved into the company's corporate office in San Diego to devote his full attention to airline sales, although retaining the title of General Dynamics/Convair president.

J. H. Famme, vice president and general manager of General Dynamics/Convair, is expected to assume presidency of that division, pending board approval. No announcement has been made of action to replace MacBride. Three other General Dynamics/Convair officials have left the firm in recent weeks. They were Jack G. Zevley, division vice president-sales, and Allen Ables and Gordon Wolcott, also commercial sales executives. Sales responsibility was then assigned to the division's contracts department.

Silence on Satellite

Air Force would not identify, through late last week, a satellite launched successfully by an Atlas-Agena B booster combination from Pt. Arguello, Calif., on Nov. 22, or elaborate on the statement that the satellite was carrying a number of classified test components.

Only two satellites—Samos reconnaissance and Midas infrared early warning—are scheduled for launch from the Arguello pads, according to programing for existing projects.

plane wing to get added lift from the air going over them as they are propelled at high speeds. The Navy's David Taylor Model Basin currently is experimenting with such configurations in hopes of developing one which will have the aerodynamic lift of the airplane wing but not the induced drag which occurs when operating within ground effect.

Among government agencies, the Navy has received the most money to date for GEMs, $3,091,768. The amounts by fiscal years: $572,000 in 1959; $574,000 in 1960; $977,768 in 1961; $968,000 in 1962. Maj. L. C. Robertson, USA, Army research coordinator in the Office of Naval Research Air Programs Office, and Lt. Col. Joseph L. Wosser, USMC, director of that office's Air Vehicle Design Branch, which has been conducting extensive GEM research, contend that "development of the GEM into a useful military transportation system is within our capabilities." They said the next logical step is to put GEMs into the field so their true potential can be tested.

Similarly, the U. S. Army Transportation Research Command feels it has conducted enough research on GEMs; now it wants the actual vehicle to test. TRECOM spokesmen said their interest centers on two types of vehicles, one about 35 by 62 ft. to take men and supplies over cleared, but not necessarily paved, roadways and the other a smaller vehicle for rough terrain.

However, so far the Army has not been able to get the money to build either of these type vehicles. The larger vehicle, known within TRECOM as LOTS (Logistics Over the Shore), ideally would carry its own 15-ton weight in men and supplies. It would unload a ship far from the invasion area and then drive over the shore and continue several miles inland. The off-road carrier would be about 20 ft. by 40 ft. and weigh 10 tons fully loaded, with half that weight as payload.

A major problem for off-road GEMs is attaining the cruise height needed to rise above obstacles. Army officials said their studies indicate they can build a vehicle which will cruise 2½ feet above the surface and be able to rise to five feet by applying a burst of power. By adding a two-foot flexible skirt all around the base of the vehicle, the Army technicians claim the off-road vehicle could probably attain a maximum hovering height of seven feet—adequate for getting over most rough terrain.

Aeronutronic Division of Ford Motor Co. is building with its own money an air cushion vehicle designed to negotiate rough terrain. It will have a flexible skirt around the base and be designed to carry a payload of up to one ton. The vehicle is slated to be finished by next year. Some members of House Science and Astronautics Committee are interested in the vehicle.

To date the Army has received $2,480,000 for GEM activities. The apportionment by fiscal years: $230,000 in Fiscal 1960; $1,100,000 in Fiscal 1961, and $1,150,000 in Fiscal 1962. TRECOM hopes to get considerably more money for GEMs in Fiscal 1963.

U. S. Marine Corps currently is reviewing GEMs to determine their worth in invasion operations. So far, the Marines have received $1,044,000 for work in the GEM field: $580,000 in Fiscal 1960; $179,000 in Fiscal 1961, and $285,000 in Fiscal 1962. The Marines, experimental GEM 3 has provided much of the basic data gathered by the Navy. The machine is scheduled to be used soon in the National Aeronautics and Space Administration research program at Langley Research Center.

All told, the U. S. government since Fiscal 1959 has earmarked $7,010,768 for research and development. The Maritime Administration received $395,000 of that total and the Army, Navy and Marine Corps the rest. The results achieved by GEM vehicles soon to be tested will determine largely the emphasis the U. S. government will give air-cushion vehicles in the next few years.

Ling-Temco-Vought Combines Divisions

Dallas, Tex.—Two of Ling-Temco-Vought, Inc.'s electronic operating units—Vought Electronics Division and Temco Electronics Division—have been combined to form Temco Electronics, a division of Temco Electronics and Missiles Co.

New division, almost wholly involved with military electronics, plans to expand its commercial product lines, according to General Manager B. H. Ciscel, formerly general manager of Vought Electronics.

Headquarters of the new operating division will be in Garland, Tex. Facilities of the operation will consist of 180,000 sq. ft. in Garland, 40,000 sq. ft. in Arlington, and 20,000 sq. ft. in Grand Prairie, with a total of more than 1,100 employes.

Farnborough Show

Society of British Aircraft Constructors has decided to cancel its 1963 Farnborough Air Show, resuming it again in 1964. From then on, Farnborough probably will be held bi-ennially, and will alternate with the Paris Air Show. Cancellation will not affect next Farnborough show, scheduled for Sept. 3-9, 1962.

News Digest

USAF-Martin Titan ICBM launch at Vandenberg AFB, was canceled here after an automatic shut-down at T − 1 sec. when a ground support equipment computer detected a possible malfunction.

Sikorsky Aircraft hourly employes will vote again on a union to represent them before Christmas in a runoff election between the Teamsters union and the Independent Aircraft Guild (AW Nov. 20, p. 27). Teamsters polled the most votes in an election last week—2,193—but did not exceed the 50% of the total cast necessary for certification as bargaining unit. The Guild polled 1,630 and there were 968 votes for no union.

Air Force awarded Space Technology Laboratories a $10-million contract for the spacecraft for the Vela Hotel program to detect nuclear explosions in space. Management responsibility for Vela Hotel has been re-assigned from Advanced Research Projects Agency to Air Force Space Systems Division. Detection instrumentation for the spacecraft will be furnished STL by Atomic Energy Commission's Los Alamos Scientific Laboratory and Sandia Corp.

De Havilland Aircraft Corp. of Canada, Ltd., has been awarded a $1.7-million contract for development of an infrared acquisition unit for the Army-General Dynamics Mauler air defense missile system. This is the first cooperative development of a missile system announced by the U. S. and Canada.

Lockheed Missile and Space Co. has received a $1.26-million contract for fabrication and test of Agena D vehicles, an advanced version of earlier Agenas.

Pratt & Whitney Aircraft JT8D-1 turbofan, powerplant for the three-engine Boeing 727, has finished its first 150-hr. endurance test. Engine, rated at 14,000 lb. thrust, has accumulated more than 1,000 test hours.

Kaman Aircraft Corp. will build 59 H-43B helicopters under a USAF follow-on letter contract which brings total production awards to about $70 million. Air Rescue Service, MATS, will operate the helicopters.

Radar contact has been made on four occasions with an object which may be the cylinder containing the Project West Ford copper fibers. The sightings, reported by Lincoln Laboratory, which conducted the West Ford experiment for Air Force Systems Command, occurred Nov. 3, 13, 15 and 22.

AIR TRANSPORT

Shuttle Boosts Eastern's Holiday Traffic

Expanded fleet makes fast turnarounds, doubling line's 1960 Thanksgiving commuter circuit volume.

By Glenn Garrison

New York—Eastern Air Lines approximately doubled its traffic in the Boston-New York-Washington market during the Thanksgiving holiday period, compared with the same period last year. Extra aircraft were added to the airline's air shuttle pool.

Holiday business for other carriers in this commuter market increased, too, but Eastern made the strongest drive and apparently showed the biggest gains. On Wednesday, Nov. 22, and Sunday, Nov. 25, the peak days, Eastern abandoned its timetable in the shuttle service, put five additional airplanes into the shuttle pool, and operated the flights as fast as they could be turned around.

Using normal 95-passenger Super Constellation equipment and also 102-seat Douglas DC-6s from the Puerto Rican service, Eastern turned flights around in as little as nine minutes. The average ran about 20-25 min. The normal shuttle fleet of 16 airplanes was increased to 21.

Over the holiday, Eastern carried its 400,000th passenger in the no-reservation, guaranteed-seat service since its inauguration last Apr. 30. Sunday was the biggest volume day, with a total of 7,500 passengers. On that day, 103 shuttle flights were made in continuous operation.

Figures for the Wednesday through Monday period are not available, but Eastern says it apparently doubled the business of the previous similar period, when the market was served by conventional flights. The doubling refers to air shuttle points alone and does not include traffic between Boston and Washington from Idlewild and Newark airports, but only from La Guardia, where the air shuttle operates. Eastern shifted most of its flights in the market to La Guardia when the shuttle began, but still operates a few from the other two airports.

Load factor figures also were withheld, but Eastern says loads were good on the peak days of Wednesday and Sunday. Actually, all figures concerning the air shuttle experiment are closely guarded by President Malcolm MacIntyre himself, who reveals some of the statistics from time to time.

To handle the peak activity, Eastern personnel worked extra shifts. Fueling was done with two tank trucks, one to each wing of an aircraft, to speed the turnaround. On Sunday, the shuttle required 28 flight crews.

Eastern said 600 passengers showed up at the air shuttle terminal at La Guardia between 7 and 8 p.m. Sunday. Schedules normally end at 10 p.m., but flights were continued until midnight to handle all the passengers. The airline said every person who wanted a flight was accommodated.

The market served by Eastern's shuttle normally is predominantly a business travel market but businessmen were in a small minority over the Thanksgiving Day holiday period, according to Eastern. The airline said students predominated. This meant a great deal of extra baggage handling, since only about 25% of the normal traffic involves checked baggage because of the business commuter character of the market. Over the holiday, nearly 100% of the passengers had baggage to be handled, including everything from suitcases to skis.

Eastern reports diversion of a number of students from youth fare tickets on scheduled flights of other carriers. Youth fare customers, being on standby basis, could not always get space in the holiday rush and came to Eastern's terminal. Since youth fares are somewhat lower than Eastern's shuttle fares, considerable change-handling was involved as Eastern personnel collected the difference.

The holiday provided a good volume of business in the market for American Airlines, too, although the airline maintained its normal schedules with the exception of one Boston-New York one-way extra section and one round trip on

Halaby Trys to End C-141 Dispute

Washington—Federal Aviation Agency Administrator N. E. Halaby is attempting to compromise the growing rift between the airlines and the military over specifications of the proposed Lockheed C-141 all-cargo turbofan transport.

The controversy, first detailed by Aviation Week (AW Oct. 9, p. 40), came to a head last month when the Air Transport Assn. formally protested to FAA that no benefits could be derived from further three-way talks on the C-141 between the airlines, FAA and military groups.

A letter from William B. Becker, ATA director of operations and engineering, said that the "broad specifications" of the C-141 will provide an airplane tailored to military needs and requirements. It added:

"It has been made quite clear that any basic changes to these specifications to afford commercial utilization of the airplane are not acceptable to the military."

In response, Halaby admitted that at this time, basic changes in specifications would be unacceptable to the Air Force. He emphasized, however, that FAA made a "strenuous effort" to obtain airline views on commercial needs and added that the Air Force "thoroughly considered" such views in preparing specifications. He added:

"We definitely feel that significant progress has been made in the development of a cargo airplane to meet both civil and commercial needs. It is our view that the commercial version of this aircraft will prove attractive to the larger U. S. carriers . . ."

In his letter, Becker said that Lockheed should discuss with individual airlines any variations it can offer to provide a commercial version of the C-141. Halaby replied that he was informed by Lockheed that it had followed "this course of action vigorously," and that model specifications for the commercial version, based on talks with the airlines, will be ready for release by Dec. 15.

Halaby, replying to a Becker request that FAA continue its attempts to ensure that the C-141 will meet civil airworthiness requirements, said this:

". . . civil certification of the aircraft is a condition of the Air Force contract with Lockheed. This in itself is an historic step forward in aircraft development from a national point of view. It is the first time, to our knowledge, that such a condition has been specified in the contract for development of a military transport aircraft."

the same route. American handled 1,780 passengers between New York and Boston on the Wednesday before Thanksgiving and 1,485 passengers on the following Sunday. Between New York and Washington, the totals were 1,474 for Wednesday and 1,096 for Sunday.

Northeast Airlines had no specifics on holiday traffic in the market, but said results were better than for the same period of last year. Pattern of service adhered primarily to normal schedules.

Eastern's no-frills shuttle has made an impact on the Boston-New York-Washington commuter market, Northeast and American acknowledge, but both report their loads are still good.

American last month switched tactics somewhat in the service, dropping its premium de luxe service and instituting "Express Service" on the routes. It now normally operates Lockheed Electra turboprops almost exclusively, with a few DC-6 schedules. The Electras are combination coach and first class. Meals have been added to a number of flights, and drinks can be bought at certain times of day.

American also increased its frequencies, now operates every hour on the hour between Boston and New York from 7 a.m. to 9 p.m., and every hour on the half hour between New York and Washington between 7:30 a.m. and 8:30 p.m. Special check-in areas have been provided to speed the express service in this market. Porters ask passengers debarking from limousines at New York if their destination is Washington or Boston and if it is their baggage is taken directly to the aircraft.

Northeast has made no recent innovations in this market. It operates 44-passenger Vickers Viscount turboprops, in all first-class configuration, as well as a few DC-6Bs, also all first class.

Northeast operates a 5 a.m. flight between Boston and New York, then an hourly service between the hours of 7 a.m. and midnight. Service between New York and Washington is hourly between 7 a.m. and 11 p.m. Some of the coach flights are operated in evening hours with both types of aircraft. Northeast also operates a good deal of nonstop service between Boston and Washington, and Boston and Philadelphia. It says its share of the Boston-Philadelphia market is about 70%, and its share of the Boston-Washington market has reached approximately 60%.

Eastern's shuttle flights operate hourly on weekdays from 7 a.m. to 10 p.m. between New York and Boston and between New York and Washington. Weekend flights last month were increased to 12 on Sunday from each city. All three airlines operate reduced frequencies on normal weekends.

Origin and destination statistics on Eastern's passengers in the market offer the following comparison between the five months ending last September and the same five months of the previous year (totals are for passengers in both directions between the city pairs):

Boston-New York

	1961	1960
May	34,968	31,427
June	45,389	23,719
July	40,020	29,780
August	52,499	31,094
September	50,845	33,570
Washington-New York		
May	36,817	30,377
June	41,708	21,344
July	33,184	24,011
August	36,109	27,617
September	41,745	33,224

It should be noted that Eastern was closed down by a strike for a good part of June, 1960, so the comparison for that month is not exact.

Island Airlines Plan Joint Attack on Costs

Washington—Aloha Airlines and Hawaiian Airlines are planning to cooperate on means of curtailing operating costs so subsidy needs can be reduced.

In a series of closed meetings here sponsored by the Civil Aeronautics Board, officials of Aloha and Hawaiian and their attorneys discussed with Board staff members ways of forming a joint working agreement that would cut subsidies. A pooling of some facilities to slice expenses was proposed but later dropped because of an inability to reach agreement on technical points.

Hawaii's two-carrier system has produced a bitter competitive struggle that has prevented either carrier from attaining a permanent, self-sustaining economic status. Majority of routes of both carriers operating the inter-island service duplicate one another. All are short-haul. Flight schedules coincide in order to accommodate peak traffic.

Aloha estimates its current annual subsidy requirements at $933,500 while Hawaiian sets its needs at $953,000. A tentative formula for a joint working agreement, which has been submitted to the Board for consideration, would reduce Hawaiian's subsidy by $116,000, Aloha's by some $67,000.

Some consideration was given during the meetings to raising fares as a means of reducing subsidy, but this is not likely to receive the support of the airlines. Aloha, fearing that a fare boost might encourage further development of a proposed state-regulated "sky-bus" service, is especially opposed to a fare increase at this time.

Both carriers are staunch supporters of a common fare system—equal rates from the mainland to Honolulu and beyond to any Hawaiian airport—and it has been estimated that this would increase revenues by $350,000 annually.

During the meeting, Hawaiian made these proposals: joint use of a link trainer for an annual total savings of $1,800, joint flight dispatch for a $15,000 savings, joint maintenance to save $75,000 and curtailed advertising for another saving of $120,000.

Carriers agreed on the joint use of a link trainer but because of different union representation of flight dispatchers, this consolidation was considered impractical. Joint maintenance was discarded because the state law would call for the formation of a third company which would be required to pay a 3½% gross income tax on services rendered the two airlines and a 5% airport use tax on all services offered. Taxation would wipe out the $75,000 savings.

The two carriers said they could agree to limit annual advertising and promotion to $100,000 each, which would bring about the $120,000 savings. Other areas of possible agreement would be reducing the number of mainland sales representatives, and eliminating tour escorts, gifts, favors, trophies and donations to all but groups such as the Air Transport Assn.

In addition, the carriers said they could agree to curtail the number of sales personnel now assigned to each island and eliminate certain commissions to non-IATA (International Air Transport Assn.) agents. The over-all formula would save Hawaiian $116,000, Aloha $67,000.

A suggestion that stop-over privileges be eliminated to save about $60,000 annually was also turned down. Hawaiian also noted that its recent increase in freight rates would add an additional $70,000 per year to its revenues. Since Aloha is not deeply involved in the freight business, it has no serious objection.

Airline Pooling

Washington—Civil Aeronautics Board last week granted U. S. airlines permission to discuss the possibility of pooling facilities, ground equipment and supplies as one means of halting the industry's rising expenses.

The Board warned that any pooling cannot include revenues, traffic or aircraft. Discussions must be completed by Dec. 31. Several industry surveys have recommended pooling as an economy measure.

Board permission to hold meetings on the pooling possibility is required to prevent any violation of anti-trust laws.

CAB to Set Fare Pattern by Mid-Month

By Robert H. Cook

Washington—Civil Aeronautics Board has served notice on the airlines that it will not be rushed into granting any fare changes and will outline its views on the entire fare situation by the middle of this month.

There are strong indications that the Board is acutely aware of the heavy impact fare changes could have on the industry, and prefers instead to convince airlines of the need for greater operational economies as an alternative. The CAB's feelings have been underscored by these recent developments:

- **Continental Air Lines'** proposal for a jet coach fare reduction of 25% (AW Nov. 27, p. 36) was rejected by a 3-2 vote of the CAB. Strong dissents were filed by Chairman Alan S. Boyd and Member G. Joseph Minetti, but the final order pointed up the majority's concern that approval might further aggravate the industry's problem of how to offset losses from low yield coach service.
- **Allegheny Airlines** was ordered to drop its low-fare, no-reservation flights between Philadelphia and Pittsburgh within 30 days. CAB said the service, also provided as a competitive measure by Trans World Airlines, was uneconomical and should require a $15 fare, rather than the present $13.64.
- **CAB told Eastern Air Lines** it would answer fare increase proposals submitted by Eastern, United, Braniff, National and Delta by mid-December (AW Nov. 13, p. 36). Each of the proposals is being studied by the CAB staff, Boyd said, and because of the complexity of the fare problems, CAB's answer will make recommendations for the entire airline industry.

Opinions on the significance of these developments vary within the industry. Fare increase supporters hailed the Continental rejection as a strong indication that CAB may approve modest increases by the same 3-2 vote. These airlines feel that their experience with low fares and falling profits makes it necessary for the Board to approve increases to uphold CAB's responsibility to keep the airlines "economically sound."

This optimism is not shared by several other carriers who feel that CAB may have rejected the Continental proposal, not because of objections to coach service or desire to approve future fare increases, but to avert the danger that the Continental fare might prove too costly for all carriers involved.

Many airlines interpret the Board action as proof that the majority voters are unwilling to change the industry's fare structure in any manner until more knowledge is gained on the entire situation.

The Board's answer next month could either repeat its insistence on better airline cooperation on such problems as "no-shows" and reducing operational costs as a means of raising profit levels, or it could spell out exactly what percentage of fare increases CAB would approve for all airlines.

The Board has no direct authority to set fares, but in the past has studied fare proposals and told the airlines what level of increase would be approved. Carriers have responded by cancelling previously filed tariffs and refiling at the suggested levels.

Some industry observers doubt that CAB will risk approval of an increase so soon after the lengthy General Passenger Fare Investigation Case. Increases granted by this case, along with CAB's approval of the abandonment of several discount fare plans, have already amounted to nearly a 20% fare boost in the past two years, they contend.

Others feel that CAB has little choice because of the industry's financial plight, and may be forced to approve small increases on coach fares alone. This, they claim, would raise coach fares closer to first-class rates, answering industry complaints that coach service has been severely diluting first-class traffic. Increasing first-class fares alone would probably increase the present rate of dilution, they said.

Most of the Board's order on the Continental fare repeated the detailed objections filed by American and TWA, and a rebuttal by Continental. The majority emphasized that "in light of the industry's low load factors and unused seats, it is unlikely this service would be operated at lower cost per passenger mile, notwithstanding the greater seating density and lower seat mile costs."

The rejection brought an immediate complaint from Continental which claimed that almost 25,000 travelers had made advance reservations for the proposed service.

"Because a majority of the CAB upheld the complaint of United Air Lines and the industry's other large carriers against Continental's Golden Jet economy fares, the American public not only may find itself denied the lower fares, but may soon be faced with the prospect of paying higher rates, for a majority of these same carriers have asked CAB for permission to raise fares," Continental said. "We cannot praise enough Chairman Boyd's and Member Minetti's concurrence that our reduced jet fare could be permitted into effect Dec. 1, if only on an experimental basis, for in the long run we believe that the merits of Continental's proposal will prove self evident."

The dissenting opinion underlined the value an experiment with the fare would have in probing the possibilities of achieving a "mass volume business" in the industry.

"The critical factor in our opinion is the elasticity of the market," the CAB dissenters said. "We believe that market response to deep fare cuts coupled with economy type service should be probed."

They added that it would have been necessary to grant the American and TWA competitive fares also in the experiment. Denying the Continental fare proposal pending investigation, as voted by the majority, may fail to offer conclusive proof of the economic worth of the service.

Hearing Considered For Southern Dispute

Washington—Public hearing on the Air Line Pilots Assn.'s 16-month strike against Southern Airways is being considered by the White House-appointed Feinsinger Commission (AW Nov. 6, p. 38).

Nathan B. Feinsinger, chairman of the commission, said last week he has completed initial talks with both the Civil Aeronautics Board and the Federal Aviation Agency on the Southern dispute, and after talking with the airline management in Atlanta, he will decide if a public hearing is desirable.

Feinsinger is also investigating the dispute at Western Air Lines, which refused to rehire flight engineers who walked out during a February strike.

In other developments in the Western dispute, the CAB dismissed a complaint of the Flight Engineers International Assn. over Western's refusal to rehire the strikers. But the Board emphasized that it was not expressing approval of Western's "deliberate management decision," in being the only one of seven strikebound airlines to refuse a White House request to reemploy the strikers pending a full-scale Feinsinger Commission investigation.

In other airline labor developments, the White House last week approved a 15-day extension to Dec. 15 for the filing of a report by a special emergency board appointed to investigate a labor dispute between ALPA and Trans World Airlines. The major issues involve recommendations made by the Feinsinger Commission to settle the long-standing cockpit jurisdiction dispute between ALPA and FEIA (AW Oct. 23, p. 35).

Hughes Tool Insists on Northeast Control

By Ward Wright

Washington—Tactics of Hughes Tool Co. now appear to be to gain control of Northeast Airlines, recapture control of TWA and then merge the two companies.

These possibilities emerged during Civil Aeronautics Board hearings held here last week to consider Northeast's current financial plight (AW Nov. 27, p. 37). During the hearings, Chester C. Davis of Hughes Tool strongly hinted that TWA control may revert to Hughes and then bluntly stated that his company would not rescue Northeast from threatened financial collapse unless it was permitted to control the airline.

Original plans to merge Northeast and TWA, formulated when Hughes Tool held voting control of TWA, were dropped when Hughes Tool's voting powers were placed in the hands of trustees.

The strong position taken by Davis during the hearings compounded CAB's already knotty problem of what to do about Northeast's financial troubles. John C. Meleney, counsel for Northeast, revealed that the company owed close to $12 million in trade accounts and will probably require about $800,000 by the first of the year.

By the hearing's end, CAB was faced with these alternatives:

- **If Hughes Tool is denied** permission to aid Northeast financially on its own terms, then it will not advance Northeast any more money—a move that could spell the end for Northeast.
- **If CAB allows Hughes Tool** to aid Northeast and eventually obtain the Atlas Corp.'s 56% interest in the airline, then Hughes Tool will ultimately own controlling interest in two large airlines—TWA and Northeast.
- **National Airlines** has indicated that if CAB rules in favor of Hughes Tool, it will take the case to the federal courts and Eastern Air Lines will probably follow suit.
- **If Northeast is allowed** to fail, then its New England routes, which are essentially local service operations, must be given to one or more carriers—possibly Mohawk or Allegheny—which will require subsidy.

At the hearing CAB was criticized by Eastern and National for the way the case was being handled. Both airlines consider the summary procedure without precedent and also consider it illegal.

National told the Board that the fact that the financial assistance involved in this case was labeled "interim" did not make the hearing legal. If this type of hearing were allowed to stand, National said, the CAB "will never hear the end of it."

Eastern and National noted that Hughes Tool had not filed an application for control of Northeast as required by CAB. National charged Northeast and Hughes Tool knew last spring the airline was facing serious financial trouble but came to the Board at the last minute in the guise of an emergency to get favored treatment.

National also said Hughes Tool's decision to withhold aid from Northeast unless allowed to control the airline made any Board decision in the case "completely moot."

Northeast told the Board that neither National nor Eastern were really concerned with the public interest in the case. Northeast cited its effective competition in the northeastern U. S. and Florida market, the 1.6 million passengers carried during the year ended last June 30, and the fact that it provides 24 communities with their sole air transportation as reasons why CAB should approve financial assistance from Hughes Tool.

Hughes Tool indicated to CAB in its brief filed Nov. 24 that the reason it had not filed an application for prior approval of control was because it was Northeast, not Hughes Tool, which was seeking assistance. Hughes Tool told the Board orally that the only issue was to determine the extent Hughes Tool was engaged in "any other phase of aeronautics" and to determine how it would affect the public interest if it were to aid Northeast.

Hughes Tool said that its activities in other phases of aeronautics, none of which should bar CAB approval of its plan to help Northeast, fall into four areas:

- **Control of TWA.** Hughes Tool said its 78.2% ownership of TWA is in the hands of a voting trust and not under its control. Therefore it should not be an obstacle to gaining control of another airline. Hughes Tool conceded that when the voting trust terminates, and it regains control of TWA, then there might be a conflict of interest if it controlled Northeast. This problem would have to be settled by the Board at the time and the firm recognizes it would be required to sell one of the airlines, Hughes Tool said.
- **Development of two-place helicopters.** Hughes Tool said this would not affect public interest.
- **Experimental activity.** Hughes Tool said its development of advanced aircraft is in the public interest.
- **Ownership of four Convair 880s** and 13 990s. Hughes Tool said it recognized that the principle of sale of aircraft by a controller to an air carrier might present a potential conflict of interest, but that the Board must give prior approval of such sales before they can become effective.

Earlier, Raymond F. Holliday, vice president of Hughes Tool and a trustee and director of TWA, filed an affidavit with CAB in which he stated that TWA was apparently seeking further financial assistance from Hughes Tool. The affidavit was filed in response to the Board's expressed interest in recent antitrust action brought against Hughes Tool by TWA.

Holliday's statement, which if true, might have weakened the position of Hughes Tool in its effort to aid Northeast, brought a quick denial from TWA. Charles C. Tillinghast, president of TWA, said his company was not seeking and did not intend to seek financial assistance from Hughes Tool.

Sage Role Uncertain Despite Beacon Report

Washington—Future role of Sage direction centers and computers in controlling air traffic remains uncertain despite Project Beacon report's recommendation that only Sage radar be absorbed by the civil ATC system.

Federal Aviation Agency and Air Force negotiations now under way probably will result in FAA controllers' manning at least three Sage direction centers. But the precise number of centers involved, their location and the manner in which they will be used by the Agency are points still at issue.

FAA officials are somewhat pessimistic that the Sage question can be settled finally within a month. One reason apparently is FAA's insistence that even a limited integration of the military intercept system and the civil ATC system be considered an interim measure.

Project Beacon report (AW Nov. 13, p. 34) specifically supports this viewpoint. It states that FAA should acquire only the long-range radar that furnishes Sage with intercept data. The substantial capital expense involved in modifying Sage for ATC use "does not appear justified particularly in view of the large penalty in operating cost which would result in the latter years of its useful life," the report said.

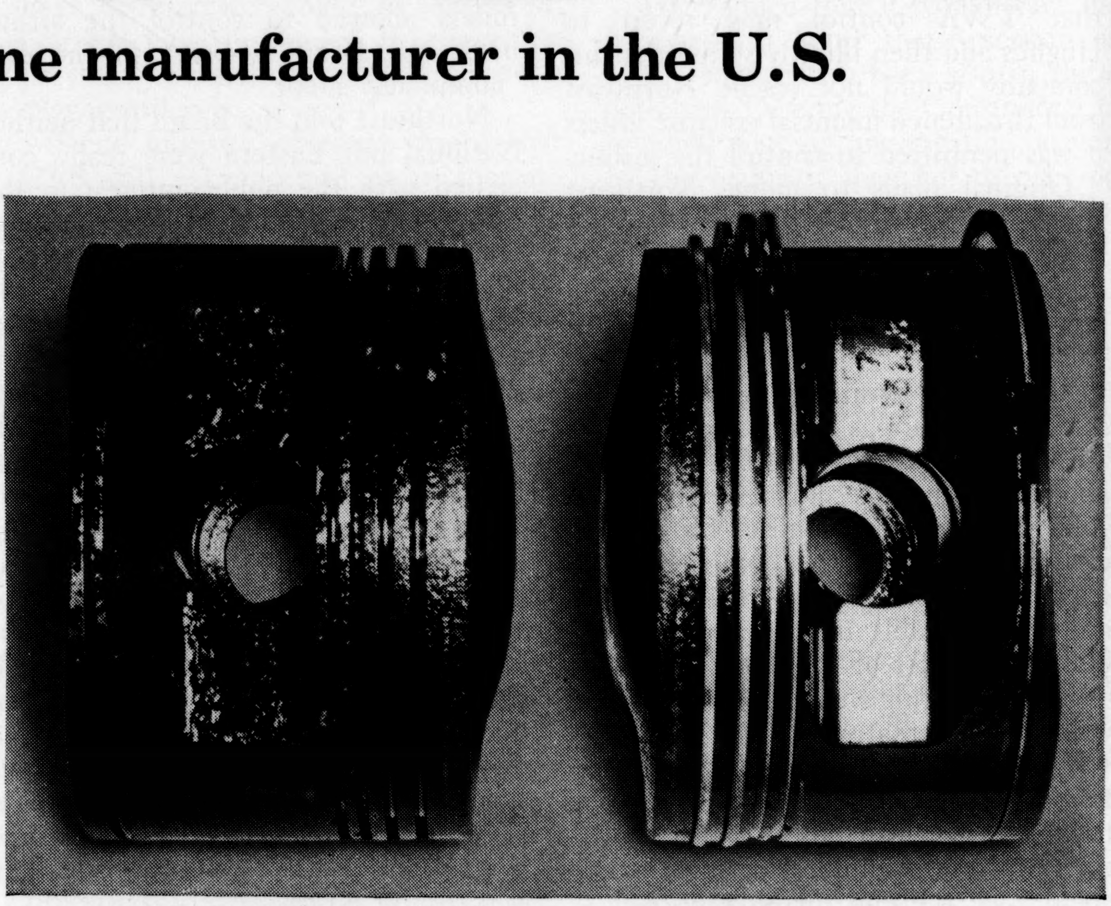
In accepting the Beacon report, President Kennedy instructed FAA Administrator N. E. Halaby to "prepare a plan and design a system to utilize those elements of the air defense system which you believe can be advantageously used in meeting air traffic control requirements."

BULLETIN:

AeroShell Oil W becomes first fully compounded additive oil to win approval of every major aircraft piston engine manufacturer in the U.S.

Aircraft, large and small, have logged millions of flight hours on Shell's new additive oil—the first fully compounded additive oil approved by every major U.S. manufacturer of aircraft piston engines.

Here are answers to 10 key questions about AeroShell® Oil W—how it helps keep engines cleaner, reduces wear—even extends periods between engine overhauls.



Left: Piston from engine using straight mineral oil after 1,000 hours; note sludge and coke. *Right:* Piston from same aircraft after 1,000 hours on AeroShell Oil W.

1. What types of aircraft can use AeroShell Oil W? Piston engine planes of any size. Helicopters, too.

2. Why is it called a non-ash dispersant oil? Because it contains special metal-free additives that help keep tiny, ingested particles in the oil from clumping together and forming deposits. These particles remain suspended and dispersed.

3. How does this affect engine performance? It means that engine parts stay cleaner. That lubrication points get all the oil they need. *Your engine can run more efficiently, parts can last longer.*

4. What about oil consumption? Because AeroShell Oil W helps provide a cleaner engine and less wear, you can expect less oil consumption.

5. Can AeroShell Oil W reduce maintenance costs? If you have been using a straight mineral oil, AeroShell Oil W can reduce your maintenance costs substantially. Intervals between engine overhauls can be extended.

6. How does this new oil respond from a cold start? AeroShell Oil W has an unusually high viscosity index. This guards against excessive thickening of the oil when cold, yet provides proper lubrication when hot. Result: *easier starting, faster warm-up.*

7. Is AeroShell Oil W thoroughly proved? Thoroughly. It's had millions of engine hours of flight time.

8. Can AeroShell Oil W be added as a make-up oil? Yes. It is compatible with all piston engine oils now being used.

9. Is there more than one viscosity grade? AeroShell Oil W is available in *three* viscosity grades: 100 and 120 grades for large engines. And 80 grade for small engines where straight mineral oil grade 55, 65, or 80 is normally recommended.

10. Where is it available? At Shell Aviation Dealers everywhere. *Any* dealer will stock AeroShell Oil W if you ask him.

Technical bulletin on AeroShell Oil W will be sent at your request. Write: Shell Oil Company, 50 West 50th St., New York 20, N. Y.

SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are helping to provide better products for industry

British United Airways, Cunard Win 22 Routes Competing With BEA's

By Herbert J. Coleman

London—Britain's two major independent airlines—British United Airways and Cunard Eagle Airways—last week were awarded 22 routes in competition with state-owned British European Airways. BUA and Cunard are now girded for an almost inevitable round of appeals.

The 22 routes, mostly to Europe, were granted by the Air Transport Licensing Board in the midst of a parliamentary furor over revocation of a North Atlantic license to the independent Cunard Eagle Airways (AW Nov. 27, p. 39) by Minister of Aviation Peter Thorneycroft.

Newest competitive licenses granted are to:

- **British United Airways**, to Paris, Amsterdam, Zurich, Basle, Tarbes, Genoa, Milan, Athens, Barcelona, Palma, Malaga and Lisbon-Madeira.
- **Cunard Eagle Airways**, to Glasgow, Edinburgh and Belfast from London, to Dublin from London and Liverpool, to Nice from Manchester and Birmingham, and to Geneva, Copenhagen-Stockholm, and to Venice.

Licensing Board made new routes effective for seven years, starting Apr. 1, 1963, to allow BEA a year's operation without diversion of traffic by the independents.

In the Cunard Eagle grant, the significant routes are within the United Kingdom, long a BEA stronghold. Another United Kingdom route was awarded to Starways, from Chester to the Isle of Man.

In all, the Licensing Board turned down 36 other routes requested by the independents. But the closing moments of the hearings did not come without incident, due primarily to Thorneycroft's overruling of the board on the Cunard Eagle grant.

This occurred when British United's presentation team, headed by counsel Gerald Gardiner, walked out of the hearing room and withdrew its application to serve Gibraltar, Freetown and Lagos.

Gardiner referred to the minister's acceptance of British Overseas Airways Corp. evidence that the state-owned airline had financial commitments for aircraft to cater to the North Atlantic services for five to six years, and retorted:

"The view taken by BUA is if that is right, the whole proceedings of the independent companies before this board have been farces."

He also said that it was really in the nature of a farce if the board carefully considered all arguments and then is overruled by one gentleman, who, however distinguished, is not an expert in this field, and he is then to be supported by the minister. This was a reference to Sir Fred Pritchard, retired high court justice, who Thorneycroft appointed as appeals commissioner and who recommended revocation of the Cunard Eagle license.

Regarding the new awards, British United noted that the total was far less than that requested and added: "It will need very careful assessment to decide whether it will be possible to operate so small a number of routes economically."

The company has ordered 10 BAC 111 medium-range jet transports for its potential expansion.

Boeing Order

Meanwhile, Cunard Eagle said it has put its two Boeing 707s, ordered primarily for the North Atlantic London-New York route, on the block after deciding it could not utilize them economically on its London-Bermuda-Bahamas route network, now flown by Bristol Britannia turboprop transports. Delivery would have been next year.

In Parliament, Thorneycroft underwent intensive questioning as to his policies on civil air transport after charges that the Licensing Board is foundering in total uncertainty after his latest ruling.

El Al Financing

New York—El Al Israel Airlines is negotiating with the Export-Import Bank for the financing of two medium-range Boeing 720Bs to be delivered in March and May respectively.

Col. Shlomo Lahat, executive vice president of the airline, said that he anticipates no financing difficulties due to the carrier's high transatlantic load factor performance during the first six months of this year (AW Nov. 6, p. 52).

Lahat said that the addition of a third Boeing 707-420 this spring will enable the carrier to increase its transatlantic frequencies during peak summer months from six weekly New York-Tel Aviv flights to 10. The 720Bs will be used to augment the Bristol Britannia flights now flying from Tel Aviv to Istanbul, Teheran and Athens.

Lahat said he does not expect the 720Bs to replace the Britannias in any foreseeable future.

The Israeli carrier currently is investigating new route structures in Africa. By next year, Lahat said, "we expect to make inroads either in East or West Africa—but not in both simultaneously."

The decision, which has caused widespread criticism from the British press and independents, has been long awaited since, under the Air Transport Licensing Act of 1960, the minister is given final powers of determination and, in effect, is a one-man tribunal (AW May 22, p. 35) with absolute legislative power over any board decisions. Because the act was designed to give wider competitive latitude to British independents, Thorneycroft's ruling came as a surprise.

Thorneycroft, referring to BOAC, said the corporation's losses this year will be about $30 million, due partly to losses by subsidiaries and associates, partly to re-equipment problems after Comet I disasters (BOAC carries an accumulated deficit of $42 million into this fiscal year), partly to strikes and importantly to traffic recession and overcapacity.

The latter problem, Thorneycroft said, "was particularly acute on the North Atlantic, where the traffic slump cannot be overcome quickly . . . and the airlines will have a very difficult time next year."

He denied that BEA and BOAC hold a monopoly on world routes and stressed that whatever the future may hold, there are now more seats than passengers.

He said that under government policy, the corporations must be run profitably and we must recognize the implications of this.

Turning to his position under the act of 1960, Thorneycroft noted it gives the minister a dual role, one as final court of appeal and another as negotiator of bilateral agreements with other countries, noting the minister has to consider very carefully how he will negotiate and what price he will ultimately have to pay.

Thorneycroft also contended that it is not the intention of the act to promote competition between British carriers for its own sake.

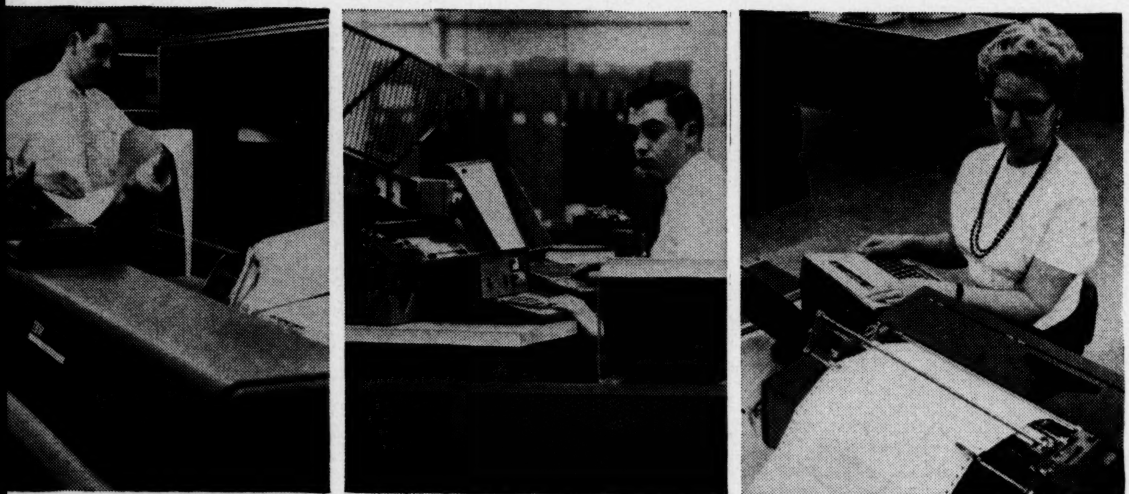
As for the Cunard Eagle decision, the minister continued:

". . . I would say that the decision or appeal in no way implies the slightest loss of confidence in the Air Transport Licensing Board—far from it. . . . The act, however, never presumed that the board, the commissioner and the minister must in all cases agree."

Other factors in the Cunard Eagle case, he went on, were BOAC's capacity to carry the traffic, evidence that BOAC intends to cut its North Atlantic capacity this year, the weakening airline travel market and the probable effects of international negotiation of traffic rights.

Inventory Management Simulator program at...

Clark Equipment... improves customer



■ High-capacity memory. Two IBM 305 Data Processing Systems with RAMAC keep track of 75,000 replacement and repair parts in Clark's Chicago parts warehouse. **■ The computer has the facts.** As soon as shipments arrive at the warehouse, an operator, using this remote inquiry station near the loading platform, finds out from the computers where various items go. **■ Customer service first.** Using this remote inquiry station in the sales department, the operator gets information from the computer while the customer is on the phone.

Clark Equipment Company has prepared a computer program called an Inventory Management Simulator. The program allows Clar management to study the possible effects of decisions on future customer service and futur warehouse profitability. When managemen gets the computer's report, it is in a position t make new rules for the operation of its part warehouse.

Here's what's happened since Clark put th new program into operation:... improved customer service... practically eliminated backorder problem . . . reduced the putaway tim for incoming material by more than 50 per cen . . . reduced emergency order shipping time b 50 per cent . . . enabled a physical inventory t be taken without any interruption of servic to customers.

rvice...with less inventory

ilability highest ever. Inventory management
complex job at Clark. Its Chicago ware-
se is one of the busiest and largest in the
ntry. Before the Simulator program was
eloped, the warehouse carried an inventory
85,000 individual replacement and repair
ts. Use of the program helped transfer the
estment in inventory to those parts most
uently called for, giving high availability
n less investment.

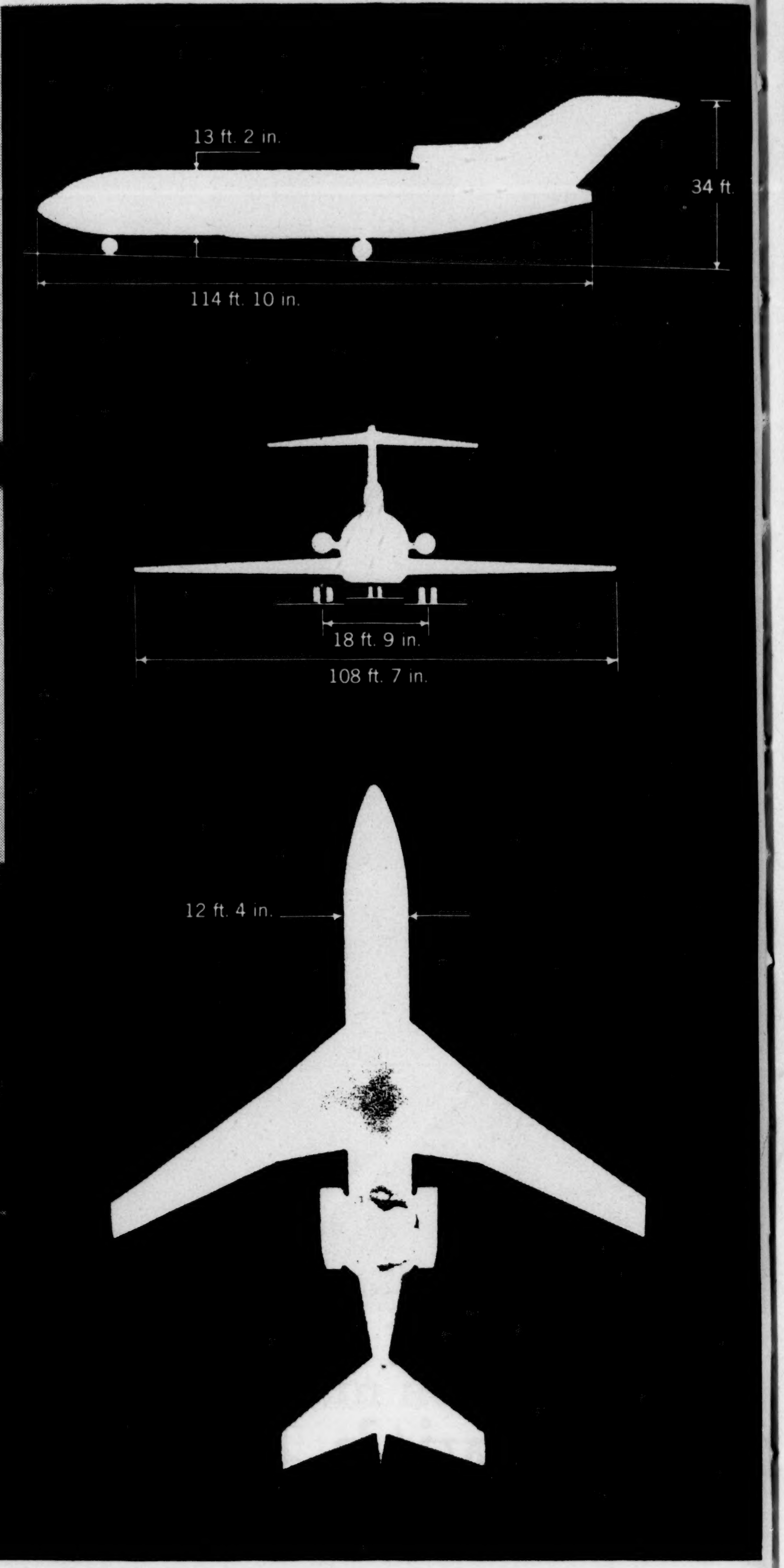
agement Operating System.* Clark installed
IBM 305 Data Processing Systems with
AC.® These computers store, update, and
r on an instant's notice information on al-
t every aspect of the warehouse operation
uding complete information on every one of
75,000 items maintained in stock.

ow, Clark is assured of maintaining just the right level of stock for each item. The procurement formulas, developed from the Inventory Management Simulator, even recommend how large a purchase order should be placed for each item and where it should be placed.

If you have an inventory problem, why not consider a simulation program? You don't have to have your own computer. We can supply you with an Inventory Management Simulator...you can rent time on a computer. Result...improve the profitability of your warehouse operation.

**A Management Operating System uses IBM computers to make routine business decisions and take action automatically ...flags problems that need management's special attention... frees management to concentrate on the big problems and on long range planning. As a result, it gives tighter control of all business operations...and helps cut costs.*

IBM®
DATA PROCESSING



The Boeing 727: a versatile, short-haul profit-maker

The trim new Boeing 727, now entering production, is a versatile airliner designed to operate *profitably* over route segments ranging from 150 to 1700 miles.

The 727's low operating cost will enable it to produce a profit at short ranges, even with modest load factors. Yet its generous cabin space (70 first-class or 113 tourist passengers) results in seat-mile economy on high-density routes, comparable to that of the largest jetliners.

The 727 will be a rugged jet capable of handling frequent landings and takeoffs. A 7000-gallon fuel capacity, plus high allowable landing weights, will enable the 727 to make frequent stops over a long distance without refueling. This and other features, such as an integral passenger stairway, will minimize service time during stops.

The 727's quick takeoff, fast climb and near-600 mph speed will result in block speeds never before attainable in short-haul operations.

Already, 117 Boeing 727s have been ordered by American Airlines, Eastern Air Lines, Lufthansa German Airlines and United Air Lines for delivery beginning late in 1963.

BOEING 727

Fuel Line Investigated in Vertol 107 Mishap

Snapping of a fuel line is being investigated as a possible cause of the fire following a landing gear collapse which last week damaged beyond repair a Boeing-Vertol helicopter undergoing hard landing tests at Mustin Field, Philadelphia Naval Base.

Two test pilots aboard the 107 were uninjured after the left landing gear failed and fire resulted. The aircraft was participating in its Federal Aviation Agency certification program and one of the pilots was an FAA representative.

It is too early to determine what effect the incident may have on the 107's certification, a Vertol spokesman said. Most recent certification date target in the delayed program was Nov. 25, but this already had been postponed to Dec. 15 because, Vertol said, of weather conditions during certain scheduled test periods.

The incident is still under investigation, but indications were that the fire resulted from a break in the interconnecting fuel line between the aircraft's two landing gear pods, which contain the fuel tanks. Vertol said it appears a fix in the fuel lines can be made to prevent a re-occurrence of the failure.

The pods also contain electrical services, but Vertol said early indications are this had no relation to the fuel ignition. The aircraft was moving after it hit the ground and the ignition may have been caused by friction.

Failure of the gear itself, Vertol said, apparently resulted, as far as can be determined at this time, from loads in excess of design limits. The sink rate during the test may have been too high. Apparently the oleo member did not fail, but part of the landing gear support structure.

The aircraft was the No. 1 production ship, and belonged to the manufacturer. Several other 107s are engaged in the FAA certification test program. New York Airways had expected to get the first of its 107s into scheduled service early next year.

Initial Government Funding Seems Assured for Supersonic Caravelle

Paris—French government ministers reportedly have agreed to provide necessary initial financing for Sud Aviation's medium-range supersonic transport project, the Super Caravelle.

This inter-ministerial decision put $25 million in 1962 budget to get the project under way. In a recently announced French four year economic plan, total cost of developing the Mach 2 Super Caravelle is estimated at $280 million. Government expenses on the project during the life of the plan (1962 through 1965) are estimated at $165 million. French economic plan states that if the project is undertaken in 1962—as it now apparently will be—the first prototype will fly in 1965 and initial production models of the transport will be available in 1968, several years ahead of current U. S. Mach 3 projects.

Foreign Aid Sought

The French, of course, are hoping to get foreign backing—technical, financial and industrial—for their supersonic transport project. Sud's current agreement with Douglas Aircraft, however, only covers the subsonic Caravelle. Douglas participation in Super Caravelle development will require a new agreement.

Sud already is working up an agreement with British Aircraft Corp., though as yet this agreement does not concern the Super Caravelle (AW Nov. 6, p. 40). Sud expects, however, that eventually BAC will come into the Super Caravelle project. If not, Sud will go it alone, or rather jointly with the private French company, Avions Dassault, which is working closely with Sud on the Super Caravelle.

French industry sources point out that France already is spending $200 million on fifty Dassault Mirage IV twin-jet bombers which won't make any money for the country. Thus, this reasoning goes, France can afford to spend $280 million to produce the world's first supersonic transport which might prove to be a commercial bonanza.

Government decision backing Sud's supersonic project was based on an aircraft somewhat larger than the Super Caravelle model first revealed during the Paris Air Show last June (AW June 5, p. 40). That model was designed to carry 70-80 passengers. The present 108-passenger Super Caravelle—which bears no design resemblance to Sud's subsonic Caravelle—has been firmed up around the following characteristics:

- **Double-S wing form** with four wedge-type engine intakes slung under the trailing edge.
- **Four 25,000-lb. thrust** Bristol Olympus type turbojets with partial afterburning and thrust reversers. Sud is interested in similar U. S. engines but to date has been hampered by U. S. security red tape. In any case, the powerplants will permit Super Caravelle cruising speed up to Mach 2.2.
- **Takeoff weight** of 198,000 lb. Passenger capacity is fixed at 108 with a seating layout of two by two and a seat pitch of 37 in.

Price of 108-passenger Super Caravelle has not yet been fixed. In its earlier, 70-80 passenger configuration, Sud was working with a price of $5,600,000.

Company officials insist, however, that the 108-passenger version will have seat mile costs much the same as its subsonic Caravelle.

Design Problems Eased

The main argument Sud put before the government in seeking financial support of its project was that the Super Caravelle would put France into the supersonic transport business before any other country. In order to get this headstart, the French have not followed U. S. and British design projects which center mostly around the Mach 3 region.

In restricting itself to Mach 2, Sud has eliminated—or has greatly reduced—many of the technical nightmares connected with supersonic transport development.

The Super Caravelle, for example, will be built with standard lightweight metal alloys.

Engineers at Sud believe that their Mach 2.2 cruising speed is probably the thermal limit for standard lightweight metal alloys. Sud isn't ruling out metal creep difficulties, however, and testing along this line is being pushed. France, moreover, has Mach 2-plus speed experience since Dassault Mirage IV bomber has been flying in this speed range for nearly two years.

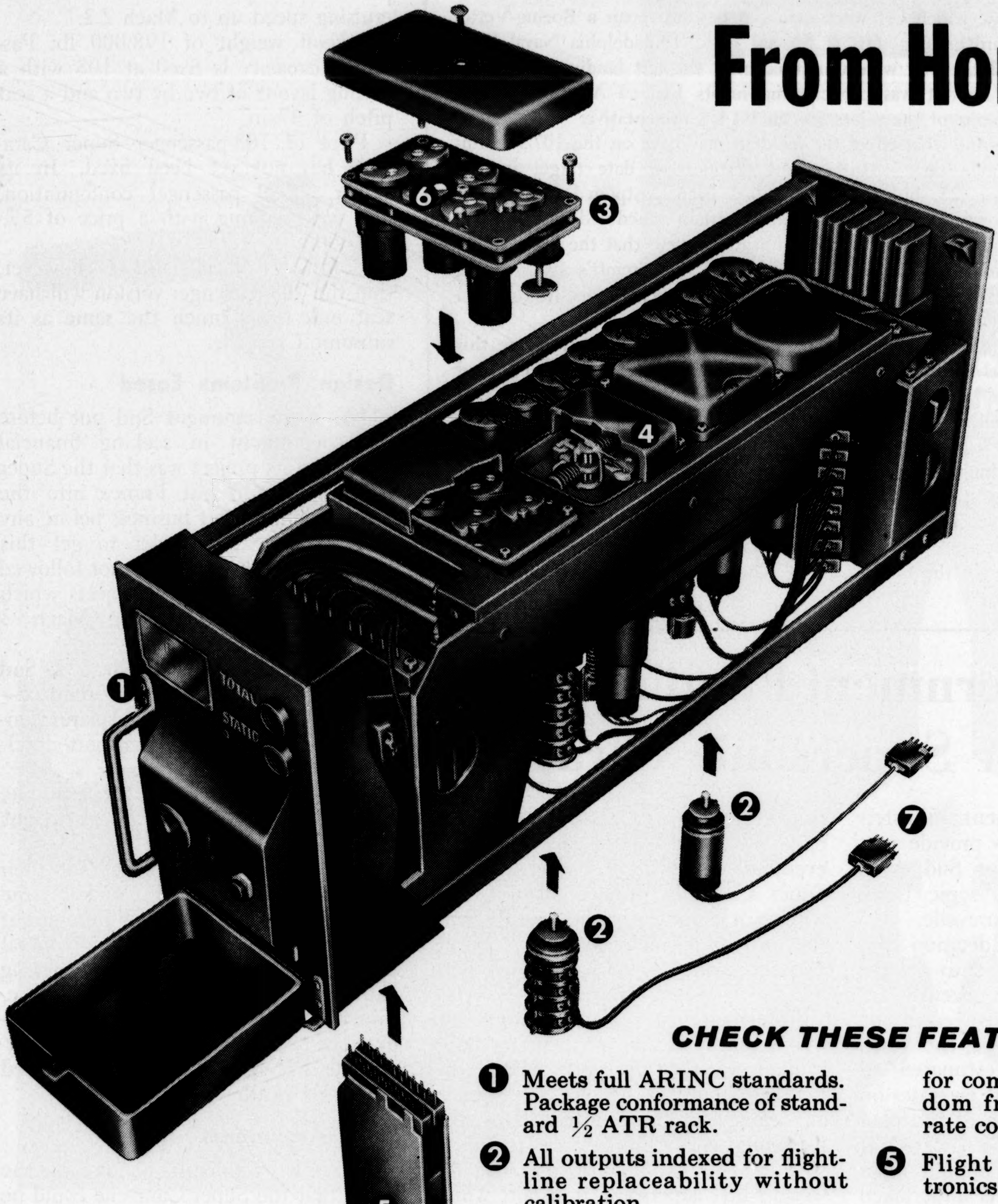
Sales Arguments

Sud's sales arguments will include the claim that the Super Caravelle could be operated under current air traffic control rules and thus will not need special ATC procedures which Mach 3 aircraft will require.

Sud's medium-range supersonic concept embraces nonstop flights between U. S. East and West coasts. This 2,500 mi.-plus range may even be extended to fit certain routes which will require somewhat more range. The idea here is that Sud, expecting to market a supersonic transport years before Mach 3 aircraft are ready, wants to tap as much of the supersonic transport market as possible.

Sud officials, of course, realize that the ideal route pattern for the Super Caravelle isn't coast-to-coast flights, but rather routes like Chicago-San Francisco or New York-Miami.

New Air Data Computer From Honeywell



CHECK THESE FEATURES:

1. Meets full ARINC standards. Package conformance of standard ½ ATR rack.
2. All outputs indexed for flight-line replaceability without calibration.
3. All replaceable items are outboard-mounted for ease of maintenance.
4. Force Rebalance Transducer dynamically balanced to allow for complete installation freedom from acceleration and rate considerations.
5. Flight line replaceable electronics.
6. Single dimension tape cams align without special tools; provide extremely clear rate signals.
7. All outputs are plug in.

Honeywell's Air Data Computer system meets the wide range of needs of commercial transport aircraft. Fulfills the complete requirements set forth by the AEEC subcommittee for ARINC. By modular construction the basic system can be expanded as requirements change.

For complete information and specifications, contact your local Honeywell representative, or contact Mr. R. W. Petersen, Honeywell Aeronautical Division, Minneapolis 40, Minnesota. Telephone: Area Code 612, STerling 1-8011, Extension 5374.

Honeywell

H HONEYWELL Military Products Group

Civil Aviation in Australia and New Zealand: Part II

Airline's Growth Perils Australian Policy

By L. L. Doty

Melbourne – Steady expansion of Ansett-ANA, privately-owned Australian airline, is creating a competitive imbalance on domestic routes that threatens to undermine the government's over-all policy of economic regulation.

The government is already expressing serious doubts over the effectiveness of its policy (AW Nov. 27, p. 46) which calls for controlled competition between Australia's two domestic trunklines, Ansett-ANA and the government-owned Trans-Australia Airlines (TAA). Ansett-ANA's progress in extending its route system into new areas the past three years has brought about a competitive distortion that should totally confirm those doubts.

TAA is saddled with a route system that, for all practical purposes, is rigidly fixed. It is unable to expand its non-competitive route system to any significant degree because, outside of Queensland and Tasmania, it lacks intra-state operating rights. Within the past year, it has been burdened with competition on two formerly non-competitive major routes, which makes their operation economically marginal for the government-owned trunkline.

Ansett-ANA, on the other hand, has gained a substantial advantage over its competitor through the purchase of six of Australia's intra-state feeder lines. As a result, Ansett-ANA now has a non-competitive route structure twice the size of that operated by TAA.

Because of this feeder system, Ansett-ANA is in a position to divert local intra-state traffic, transferring to trunklines, from TAA to its own services. Its success in winning equal frequencies of schedules with TAA on the Darwin-Alice Springs-Mount Isa route will have a depressing effect on TAA.

Entrance of Ansett-ANA on the Port Moresby-Lae and Lae-Rabaul routes, both the highest traffic density routes in New Guinea, made further cuts into TAA's gross revenues.

Ansett Empire

Ansett-ANA is controlled by Ansett Transport Industries, which is headed by Reginald Myles Ansett, 30-year veteran of aviation and other transportation in Australia. In addition to the airline companies it operates, Ansett Industries operates some 250 motor coaches and cars in Australia, a fleet of trucks and trailers for freight and a hotel system accommodating over 1,500 guests.

In the aviation field, Ansett's ambitions go beyond a purely domestic operation. It is no secret here that he has long desired an overseas route, particularly in the southeast Asia area. He holds an interest in Cathay Pacific Airways of Hong Kong and in South Pacific Airlines of New Zealand. He has made steps toward a Tasman Sea operation.

Officials in aviation circles here feel that he is interested in developing a low-fare, mass-traffic operation from Australia to Europe. If undertaken, the impact on Qantas–Australia's sole international flag carrier–could be severe.

Ansett's success in taking over the sizable Australian National Airways in 1957, winning control of Butler Air Transport after a court fight and the subsequent absorption of the small feeder lines has brought accusations of monopoly against him. In addition, the government has often been accused of granting Ansett favors that would lead to a monopoly.

Earlier this fall, the government of Prime Minister R. G. Menzies was accused by the Labor Party of abetting Ansett in its attempt to purchase East West Airlines, sole competitor of the Ansett-owned feeder line in New South Wales. East West turned down the Ansett bid last year but its president, R. Shand, holds that he has since been continually pressured by the Department of Civil Aviation into accepting the offer.

The government has vigorously denied the charges and Ansett counters them by openly supporting the government's dual airline competitive system on domestic routes and by persistently advocating the free enterprise system. Ansett supporters point out that Ansett earned his present position through public support, that his airline continually makes inroads on TAA's traffic

First RAF Comet 4C Flies

First of five de Havilland Comet 4C transports for Royal Air Force is shown on its maiden flight from company's Chester production facility. Airplane, powered by four Rolls-Royce RA.29 Avon turbojets, will be assigned to RAF Transport Command. Aircraft is fitted with seats for 94 passengers and can be converted to carry 12 stretchers and 6 berths, with seats for 47 persons.

and that, in four years, Ansett-ANA has made prodigious progress to give TAA its first serious competition since TAA was organized by the Labor Party 15 years ago.

In four years, Ansett has integrated personnel from various airlines into an efficiently operating staff, although there is still evidence of resentment from a few veteran ANA personnel. A complete new fleet of turbine aircraft operating at an impressive utilization rate has been introduced into the merged systems.

It is difficult to determine now the full effect Ansett-ANA's present operations are having upon TAA's financial position. Domestic traffic in Australia declined 1.2% during the year ended June 30, due primarily to slippage in the Australian general economy last year. A lifting of stiff credit restrictions by the government earlier this year is expected to bolster the economy which, in turn, should generate new airline traffic.

During the year, TAA reported a 2.4% increase in the volume of passengers carried compared with the previous fiscal year. However, this increase was attributed entirely to the beginning of TAA service between the mainland and Papua-New Guinea on July 9, 1960. Passengers carried within Australia proper declined 3.5% during the year ended June 30.

The number of first-class passengers during the period dropped 7% while volume of tourist-class passengers rose 3.7% on all routes. So far this year, there has been no decided reversal of last year's dismal showing.

Slim Profit Rise

Revenue load factor remained about the same during the two periods. Expenses climbed in smaller proportion to the increase in revenues to permit a slight boost in net profit, thus continuing TAA's record of a profit each year since 1952.

TAA is showing concern over its recent failure to maintain a normal traffic growth pattern and openly lays the problem to the government's regulatory policy. The government, through the Department of Civil Aviation, insists that its decisions on the equalization of schedules have been based on the need to maintain rather than suppress the "keen competitive element which is a primary justification for the two-airline policy."

As an arm of the government, TAA cannot afford to be too critical of government action, even though it may feel it is the victim of such action. In one case, in which an appeal was made for fairer equalization of capacity, a ceiling load factor was set at 68% for both TAA and Ansett-ANA. TAA claims that, since its load factor was already in that area while Ansett-ANA's was less, the decision forced it to reduce its capacity, and caused a "spillover" of traffic from TAA to Ansett-ANA.

At present, TAA and Ansett-ANA are operating comparable equipment, which means that the competitive struggle between the two carriers is based solely on performance, services, promotion and advertising.

TAA is studying the market for a jet transport, which both carriers will be permitted to order next year, and hopes that it will not be forced to buy the same type as its competitor so that it can restore the equipment advantage it had earlier. TAA appears to favor the Caravelle. Ansett-ANA has been noncommital as to its choice.

TAA does not share Ansett-ANA's enthusiasm for the future of helicopter operations in Australia, probably because it does not enjoy the strong hold on feeder services that Ansett has.

As of March 31, Ansett operated a fleet of 54 aircraft throughout the Ansett-ANA and feeder line systems. The aircraft included three Lockheed Electra turboprop transports, five Vickers Viscount 800 and five Viscount 700 turboprops, seven Fokker F-27 turboprops, two Douglas DC-6Bs and five Convair 440s. In addition, the company owns three Bell 47J helicopters, two Sandringham flying boats and one Catalina amphibian. An additional fleet of small aircraft is used for charter work.

TAA operates a fleet of 37 aircraft including three Lockheed Electras, two Vickers Viscount 800s, seven Viscount 700s, nine Fokker F-27s and two DC-6Bs. Independent carriers operate smaller aircraft such as the Douglas DC-3, de Havilland DH-104, Cessna 180 and the Beech C.18s, although East West and MacRobertson Miller each operate one Fokker F-27.

A serious problem facing both Ansett-ANA and TAA is added competition from ground transportation. In the past, railroads had not been much competition because of the need to change trains when passing from one state to another, due to the difference in track gauges on the majority of state-owned railroads.

Next year, a standard gauge railway service will be placed between Melbourne and Sydney, one of the most profitable air routes in Australia. Modern sea ferry service between Australia and Tasmania has already made a deep impact on airline revenues.

(This is the second of four articles examining the civil aviation situation in Australia and New Zealand.)

Argosy Makes First BEA Cargo Flight

First Armstrong Whitworth AW 650 Argosy for British European Airways made its initial cargo flight from Manchester to Paris recently, hauling seven tons, mostly machinery. BEA is awaiting delivery of two more Argosys for scheduled flights to Paris, Jersey, Milan, Copenhagen, Dusseldorf and Frankfurt.

Airline Income and Expenses—Third Quarter, 1961

	Passenger Revenue	U.S. Mail	Property *	Charter	Federal Subsidy	Total Operating Revenues	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNKS								
American	$96,244,639	$1,954,806	$8,718,362	$ 747,997	$ ----	$107,991,118	$102,922,652	$3,242,420
Braniff	17,325,700	457,387	1,096,199	336,507	----	19,323,347	18,528,071	634,029
Continental	15,253,704	282,169	715,501	35,125	----	16,433,403	14,997,208	748,767
Delta	33,240,666	673,792	2,027,397	75,959	----	36,121,139	35,184,712	729,466
Eastern	57,604,536	1,338,726	2,956,791	----	----	62,286,465	70,024,670	−8,253,243
National	17,958,143	447,402	1,286,531	264,503	----	20,123,600	20,089,342	−479,430
Northeast	12,938,000	180,761	460,508	25,908	----	12,751,494	14,532,619	−2,393,091
Northwest	20,521,949	595,968	1,443,535	64,179	----	22,697,677	20,706,666	1,449,086
Trans World	70,589,771	1,451,051	4,632,259	469,841	----	78,004,345	76,733,381	−3,050,905
United	122,424,589	3,968,458	8,580,884	501,119	----	136,644,368	136,153,260	993,219
Western	16,968,282	320,725	555,994	221,241	----	18,162,732	16,648,277	990,585
INTERNATIONAL								
American	1,513,836	6,568	215,786	14,757	----	1,833,935	1,748,442	46,818
Braniff	2,422,764	108,879	285,382	613,775	----	3,493,756	3,477,294	−56,681
Caribbean Atlantic	927,735	8,644	54,055	10,079	----	1,014,958	907,497	107,885
Delta	459,123	1,316	29,145	----	----	491,045	651,480	−168,755
Eastern	8,561,807	150,585	427,584	----	----	9,125,951	7,807,359	1,183,765
Mackey	390,226	----	16,250	44,307	----	465,837	502,012	−38,267
Northwest	7,597,979	2,013,849	1,014,872	539,070	----	11,632,934	8,350,011	3,005,788
Pan American Combined	105,693,276	7,672,725	13,661,217	11,244,052	----	140,796,263	120,483,544	19,420,398
Alaska	1,532,826	57,436	192,795	----	----	1,809,628	1,671,732	235,125
Atlantic	52,858,558	3,615,184	5,699,537	6,908,902	----	70,091,472	60,316,661	11,166,958
Latin America	25,573,153	667,470	4,284,893	599,991	----	32,071,707	29,000,073	3,287,822
Pacific	25,728,739	3,332,635	3,483,992	3,735,159	----	36,823,405	29,509,017	7,692,155
Panagra	4,174,360	190,942	971,993	36,128	----	5,925,336	5,447,176	363,584
Trans World	22,662,969	1,983,976	2,114,850	884,682	----	28,272,998	23,961,106	1,002,200
United	8,577,268	302,212	263,505	----	----	9,142,985	6,518,006	2,578,331
Western	1,607,611	6,944	34,925	----	----	1,660,132	1,222,950	403,746
LOCAL SERVICE								
Allegheny	3,533,940	68,390	206,586	13,313	1,624,606	5,472,680	5,071,064	233,909
Bonanza	1,377,808	11,670	38,245	1,583	861,339	2,301,382	2,093,093	147,860
Central	1,012,356	39,902	68,044	7,599	860,037	2,003,789	2,128,173	−128,539
Frontier	1,908,893	45,751	130,774	21,305	1,817,308	3,945,924	3,690,945	243,547
Lake Central	1,508,188	33,566	86,212	10,488	1,064,321	2,706,847	2,706,153	− 60,540
Mohawk	3,276,557	44,592	134,300	138,538	913,513	4,594,456	4,384,861	95,308
North Central	4,481,745	103,377	255,140	13,153	2,087,709	6,969,383	6,249,837	664,674
Ozark	2,011,613	47,609	154,950	17,490	1,088,531	3,347,018	3,130,680	180,369
Pacific	1,743,335	37,769	58,693	8,285	1,015,022	2,881,183	2,572,524	233,619
Piedmont	2,302,473	34,641	96,418	44,719	1,189,790	3,702,284	3,314,814	344,503
Southern	1,481,626	51,345	96,293	18,222	1,046,796	2,702,434	2,521,246	144,871
Trans-Texas	1,365,259	37,100	91,101	19,021	1,073,155	2,598,086	2,525,820	52,043
West Coast	1,744,697	29,029	63,842	14,888	1,277,284	3,143,099	2,745,248	335,129
HAWAIIAN LINES								
Aloha	1,614,464	6,225	20,948	12,500	29,191	1,764,017	1,478,592	221,285
Hawaiian	2,275,719	9,332	259,901	4,838	27,635	2,615,686	2,160,071	380,088
CARGO LINES								
Flying Tiger	----	13,519	2,587,575	5,875,836	----	8,519,731	8,536,866	−501,885
Slick	----	----	----	3,748,267	----	3,858,096	3,206,027	721,708
HELICOPTER LINES								
Chicago Helicopter	370,780	16,205	1,974	350	387,106	776,522	805,764	−29,234
Los Angeles Airways	74,581	34,332	44,126	----	277,255	431,495	384,034	50,280
New York Airways	297,806	11,067	17,938	25,912	582,480	927,556	996,793	−73,181
ALASKA LINES								
Alaska Airlines	300,989	147,923	185,831	446,087	466,063	2,136,334	2,280,726	−81,565
Alaska Coastal	370,381	29,505	42,842	18,455	147,058	619,304	573,397	39,575
Cordova	75,717	31,332	53,009	140,162	80,156	386,306	376,978	5,690
Ellis	230,888	14,235	24,381	9,024	82,698	371,766	344,264	23,667
Kodiak	80,163	2,777	9,145	41,936	5,318	139,988	111,848	29,359
Northern Consolidated	416,081	194,174	175,678	63,773	237,115	1,105,246	987,855	87,611
Pacific Northern	2,689,816	260,246	421,555	2,178	317,664	3,744,100	3,101,824	633,990
Reeve Aleutian	520,124	137,862	144,136	102,622	----	921,269	588,775	340,032
Western Alaska	33,064	5,362	2,933	26,642	73,010	142,157	78,765	58,271
Wien Alaska	578,537	209,041	165,582	287,219	399,703	1,661,008	1,450,722	184,926
Avalon Air Transport	236,148	4,360	3,198	5,770	----	249,913	207,138	41,841

Figures for South Pacific, Trans Caribbean, Aerovias, Riddle and Seaboard World were not available.

* Property figures include freight, express and excess baggage.

AIRLINE OBSERVER

▶ Look for serious merger talks between Cunard Eagle Airways and British United Airways, the two largest British independent airlines. Initial merger consideration may have been prompted by failure of Cunard Eagle to win transatlantic operating rights.

▶ **On-time departure record of the airlines may be headed for a sharp drop because of growing antagonism between the carriers and their ground maintenance personnel. At least one major union has advised its members to follow company maintenance manual procedures to the letter, regardless of any verbal orders to the contrary. Key phrase emphasized by the union is "do not be concerned with a delay." A recent notice added that "human lives depend on your work . . . on time departures do too, but they can wait."**

▶ Watch for the Federal Aviation Agency to circulate an internal directive that, in effect, will approve parts of former Administrator E. R. Quesada's plan to broaden the authority of the agency's Research and Development Service. Agency Bulletin 61-1, a controversial order issued by Quesada on Jan. 13 but never implemented, gave the service power to identify "the need for modifying or improving planned and installed air navigation, traffic control, communications and related equipment, facilities and systems."

▶ **Early indications are that November traffic on domestic trunklines will show an upward trend.**

▶ Strongly worded statements have been filed by Alitalia and Scandinavian Airlines System with the Senate Commerce Committee's aviation subcommittee (AW Nov. 27, p. 50). SAS bluntly charges the Air Transport Assn., which SAS says is supported by Pan American and TWA, with waging an "intensive campaign of propaganda and pressure tactics" against foreign flag carriers. The airline said the campaign is based on many "untrue and specious" arguments designed to show that U. S. carriers are "benign and in the public interest" and that foreign airlines are "predatory and evil."

▶ **Planned formation of a new London Airport Authority to take over management of the city's international airports from the Ministry of Aviation may be delayed up to a year because enabling legislation has not yet been written. The authority was recomended by a parliamentary select committee on estimates (AW Aug. 7, p. 43).**

▶ National Flight Data Center is scheduled to begin operation early in 1962 under Federal Aviation Agency's Air Traffic Service. FAA will issue uniform standards for aeronautical charts now produced independently by U. S. Coast and Geodetic Survey, the military services and several commercial firms. Long-range FAA plans call for "a coordinated world-wide network" of such centers to serve U. S. and international aviation.

▶ **Braniff Airways has refiled its petition for subsidy on its international routes after the Civil Aeronautics Board denied the original request. The Board turned down the request on grounds that Braniff failed to "set forth a detailed economic justification. . ." of the need and added that petitions which are "defective" will be denied "without leave to amend."**

▶ Brazil has denounced bilateral air transport agreements with The Netherlands, Switzerland, Norway, Sweden and Denmark on grounds that obsolescence of terms call for renegotiation.

▶ **San Francisco and Oakland Helicopter Airlines (AW Oct. 30, p. 39) has instructed its pilots to report periodically local weather conditions and automobile traffic jams observed during flights for use by local radio stations. The program has provided the carrier with a substantial amount of promotion at little or no cost.**

▶ U. S. and Ireland last week opened talks on an amendment to the bilateral air transport agreement between the two countries. U. S. is seeking rights to serve Dublin with beyond rights to London and European ports of entry.

SHORTLINES

▶ **Alitalia** reports it has revised its sales organization by designating six sales territories in North America and one in Central America. Regions and their headquarters are: Eastern, New York; Midwestern, Chicago; Central, Cleveland; Southern, Miami; Western, Los Angeles; and Canadian, Montreal. Six executives were promoted to territorial managers.

▶ **Delta Air Lines** has begun weekly round-trip service between San Francisco and Caracas with Convair 880 jets. Flight makes stops at Dallas, New Orleans and Montego Bay, Jamaica.

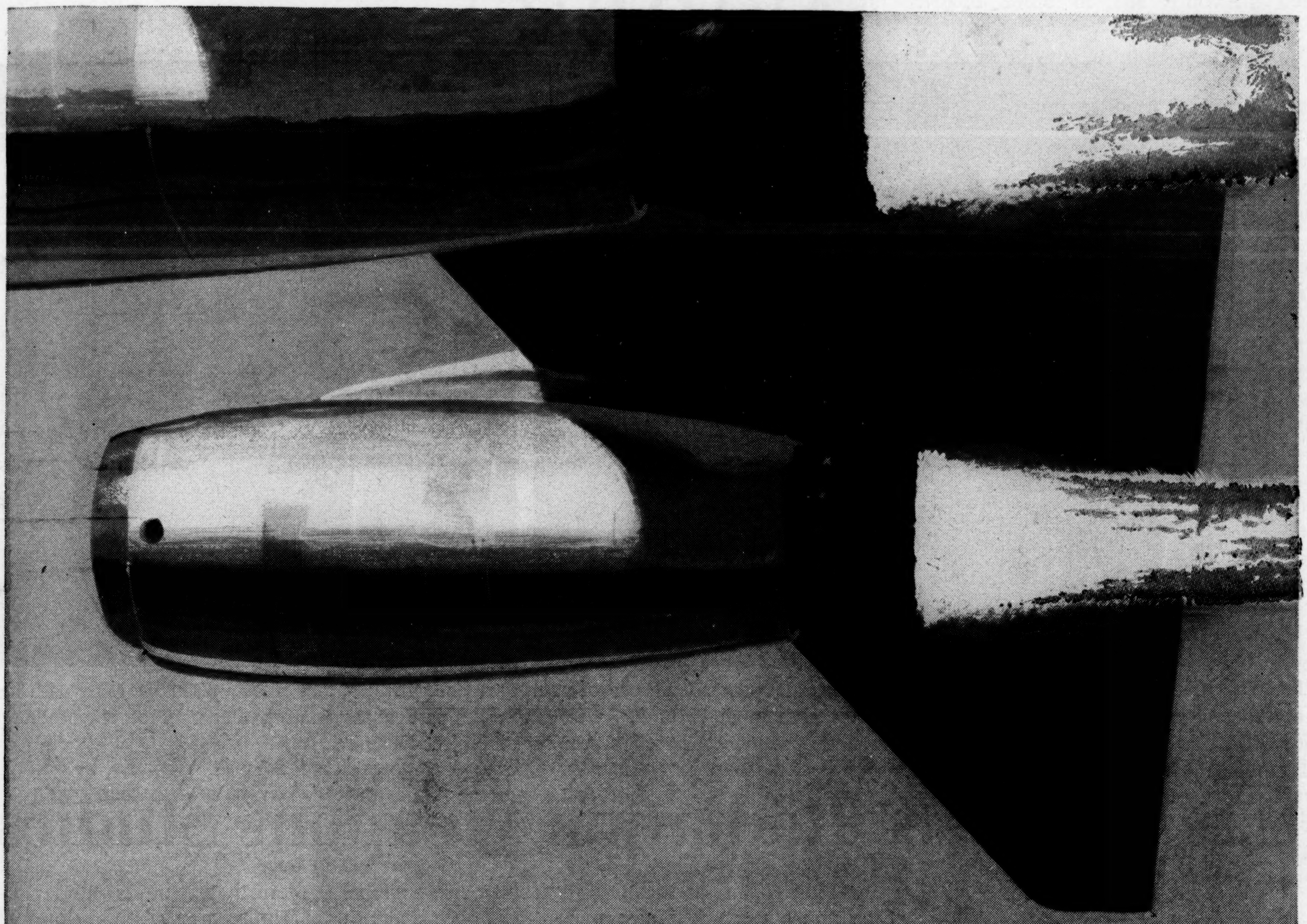
▶ **Eastern Air Lines** will service Trans World Airlines flights at Binghamton, N. Y.; Allentown - Bethlehem - Easton, Reading and Wilkes-Barre, Pa., beginning Dec. 15. TWA said consolidation of ground services at small airports having low frequency schedules will save money and is in line with recommendations made by Civil Aeronautics Board Chairman Alan S. Boyd (AW Nov. 6, p. 37).

▶ **Initial decision** of CAB examiner in the reopened Puerto Rico Fare Investigation concludes that the present fares of Eastern, Pan American, and Trans Caribbean airlines between New York-Newark and San Juan and Miami-San Juan for first, second and third class be allowed to stand—and that the jet surcharge be dropped.

▶ **Lounges** for first-class passengers have been installed for Eastern Air Lines' customers at Idlewild, Miami and Atlanta airports. Children's areas, color television, telephones, and desks will be provided, along with food snacks and soft drinks, and alcoholic beverages will be sold.

▶ **Pacific Northern Airlines** reports a net income of $396,435 for the first nine months of 1961—a 184% increase over the $139,488 earned during the same period last year. Total revenues for the first nine months of 1961 increased 9% over the same period last year.

▶ **Pan American World Airways** and Middle East Airlines, the Lebanese flag carrier, have agreed to provide representation and sales facilities for each carrier in certain of the other's major markets. The agreement gives Pan American a link with Middle East's routes and provides the Lebanese carrier with sales outlets in North America, Asia and the Pacific.



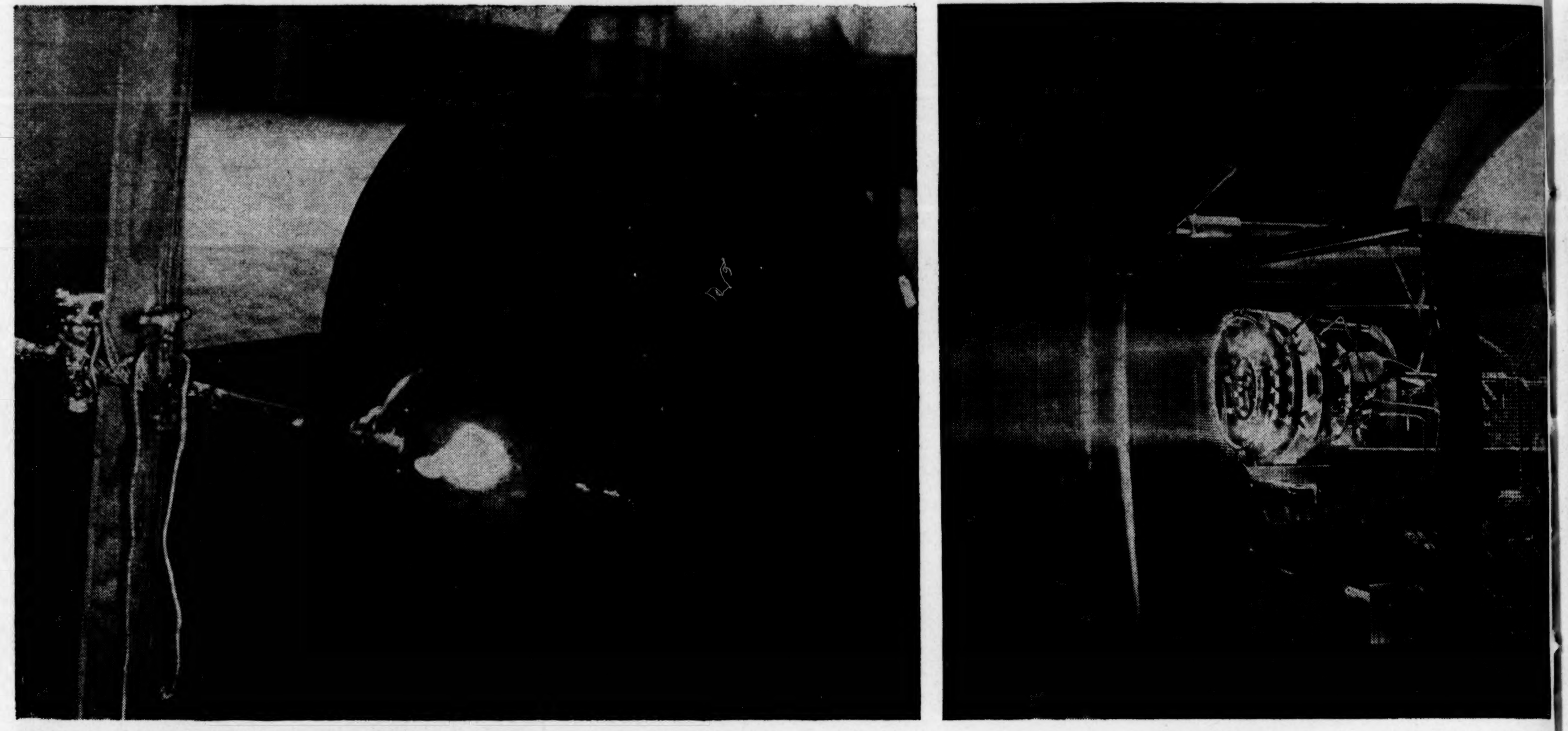
Confidence counts and the airlines count on Sinclair

45% of the aircraft oil used by major scheduled airlines in the United States is supplied by Sinclair. Military jets also count on Sinclair to supply Sinclair Aircraft Oil to lubricate their mighty engines. There is no better proof of reliability.

Sinclair AIRCRAFT OILS

Sinclair

Sinclair Refining Company Aviation Sales, 600 Fifth Ave. • New York 20, N. Y.



EXOTIC ICBM defense techniques now under investigation include use of microwave energy to produce plasma discharge (left) with the objective of producing artificial lightning balls. Another approach under investigation uses particle accelerators, similar to ion engine shown (right). These and other exotic ICBM defense weapon concept studies are part of Project Defender.

U.S. Increases Radiation Weapons Studies

By Philip J. Klass

Washington—United States is stepping up the pace of its research on exotic weapons, broadly referred to as "X-weapons," as a possible defense against ICBMs. These bear a slight resemblance to the "death ray" concepts of science fiction.

Much of the effort centers on plasmas, one of the oldest yet least understood electrical phenomenon. There is strong evidence that similar work is under way in the USSR, aimed at the same objective.

Most of the broad basic research effort in X-weapons in the U. S. is sponsored by the Advanced Research Projects Agency (ARPA) as part of its Project Defender program. Current budget for Project Defender is about $100 million annually.

But a number of organizations and companies, unable to obtain Defense Department support, are carrying out modest research programs with their own funds.

Barring an unanticipated breakthrough, the present state of research suggests that any effective ICBM defense using X-weapons probably is at least five years away, and perhaps a decade off.

The U. S. effort is like an iceberg in that only a small fraction of the total appears above the surface of military security.

Here are a few examples:

- **Rome Air Development Center** in August was seeking research and development sources for "continued investigations of energy transfer and transformation processes in plasma . . . for measurements in wind tunnel experiments under the radiation weapon feasibility program . . ." as listed in the Commerce Department daily synopsis of government planned procurement. RADC is conducting its own in-house experiments in the use of microwave radiation to produce plasma (AW Sept. 25, p. 303.) It reportedly also asked for industry proposals for design study on the feasibility of radiation weapons using optical masers (AW Oct. 23, p. 19).
- **Air Force Cambridge Research** Laboratories recently announced plans to build a $636,150 gaseous physics research facility which will be used to explore "communications blackout due to plasma sheaths or nuclear detonations, remote control of atmospheric ionization, weapon feasibility and power coupling and transmission effects," according to the AFCRL announcement. The latter items have important implications for ICBM defense. The new facility, slated for completion next fall, will be able to generate high-level RF power across the spectrum, from UHF to 140,000 mc. At 3,000 mc., the facility will be able to generate more than 10 megawatts.
- **Raytheon Co.** last spring received an Air Force contract for study of high-energy spherical plasmoids, under direction of the company's Dr. Paul A. Silberg. In response to an Aviation Week query, a Raytheon spokesman declined to provide additional details because of military security. However, several months before the contract award, Silberg submitted a paper to the Journal of Applied Physics, published in January, 1961, entitled: "On the Question of Ball Lightning." In the article, Silberg discusses a theory advanced in 1955 by Dr. Peter L. Kapitsa, one of the USSR's top physicists, to explain natural ball lightning. At that time, Kapitsa suggested that the phenomenon might be produced artificially using radio frequency energy.
- **USAF's Lt. Gen. Roscoe C. Wilson,** testifying before the House appropriations subcommittee on Apr. 16, 1959, in response to a question from Chairman George H. Mahon, said: "The Air Force death ray program involves research in the possible use of radiation energy as the lethal technique in an Air Force weapon." This is believed to be a reference to an Air Force program with Varo Manufacturing of Garland, Tex.
- **At ARPA's ICBM defense** symposium, held in February, 1960, Dr. Arnold T. Nordsieck presented a paper entitled: "Particle Accelerators and Radiation Weapons." Although the conference itself was classified "secret," the program listing the papers by title was unclassified. At that time Nordsieck was

a professor at the University of Illinois, but recently left to become director of the technical specialties department of General Motors Defense Systems Division in Santa Barbara, Calif.

Current emphasis on X-weapons stems from U. S. studies of the ICBM defense problem over the past several years, with some additional impetus provided by recent statement by USSR Defense Minister Rodion Malinovsky that the "Soviet Union has solved the problem of anti-missile defense."

These studies indicate that if defense is based on interception by a missile during warhead re-entry, the current Nike Zeus probably is as good an approach as any likely to be devised at this time.

Cost Is 'Staggering'

But the cost of implementing a Nike Zeus type defense in sufficient strength to prevent saturation and provide an effective defense is staggering. Some estimates range as high as $50 billion.

ARPA is funding feasibility studies of another approach to ICBM defense, known as ballistic missile boost intercept (Bambi), which would use thousands of satellites in orbit, each bearing small interceptor missiles which would attempt to deflect enemy ICBMs during their boost phase (AW Oct. 23, p. 82).

However, the cost of building and placing thousands of such satellites in orbit, and replacing those knocked down by enemy counter-measures, appears to be so high as to place the whole concept in question, in the opinion of some top Defense Department officials.

These are some of the considerations that have focused interest on the more exotic types of weapons.

If the idealized "death ray" of science fiction were achievable, it would offer several important advantages over Zeus and Bambi concepts. Because such a "ray" travels at the speed of light, there is no need for complex ground-based computers to predict future intercept position of the warhead and to calculate guidance commands for the anti-ICBM missile. For similar reasons, target kill would be almost instantaneous, enabling the idealized death ray to handle many more threats, decreasing the possibility of saturation.

The most likely candidate for the death ray role has, until recently, been high-power microwave radiation. There is no question that presently available multi-megawatt levels of power can harm and perhaps even kill humans at close range. Extensive precautions must be taken with current high-power radars, such as the Ballistic Missile Early Warning System (BMEWS) to prevent injury to operating and maintenance personnel.

But the use of high-power microwave radiation to disable or destroy an ICBM warhead, which is designed to withstand the extreme heat and shock of re-entry, is a far more difficult problem.

At suitable re-entry intercept altitudes of 100 mi. or higher, the power level of a ground-based radar beam is heavily attenuated and dispersed. For example, the largest spherical radar antenna ever built in the West, measuring 1,000 ft. in diameter, now under construction in Puerto Rico under ARPA sponsorship, will have a beam width of 1/6 deg. at its operating frequency of 430 mc.

At an altitude of 100 mi., the beam energy would be distributed over a circular area 1,500 ft. in diameter. Even if the frequency were increased by a factor of 10, the beam width at that altitude still would be 150 ft. At higher frequencies needed to compress the beam further, the power available from tubes falls off proportionately, so there is no net gain in energy concentration.

Laser Possibilities

The advent of the optical maser (laser), with its inherently small beamwidth and narrow bandwidth emission, has raised the possibility that it might eventually develop levels of energy concentration needed for use as a possible "death ray."

The recent Defense Department survey of 49 top electronic industry scientists and executives, seeking their views on the most important areas of electronic research (AW Oct. 23, p. 51), evoked some of the following comments:

- **"A significant amount of attention** is being given in our laboratories to research in . . . generation of coherent radiation in the optical and infrared spectrums. The availability of coherent techniques at these wavelengths . . . may lead to opportunities in exotic weaponry."
- **"The ability of the optical maser** to transform efficiently broadband energy into the energy of a single optical line makes it possible to concentrate the emergent coherent light to a fine focus and . . . by concentration of an adequate amount of energy, even the destruction of enemy missiles. . . ."
- **"Focused electromagnetic** or particle energy . . . is still in the feasibility study category where it as yet has not been proven either feasible or infeasible. However, if large amounts of energy can be focused on distant points in space, we are a long way toward being able to . . . destroy objects in space."

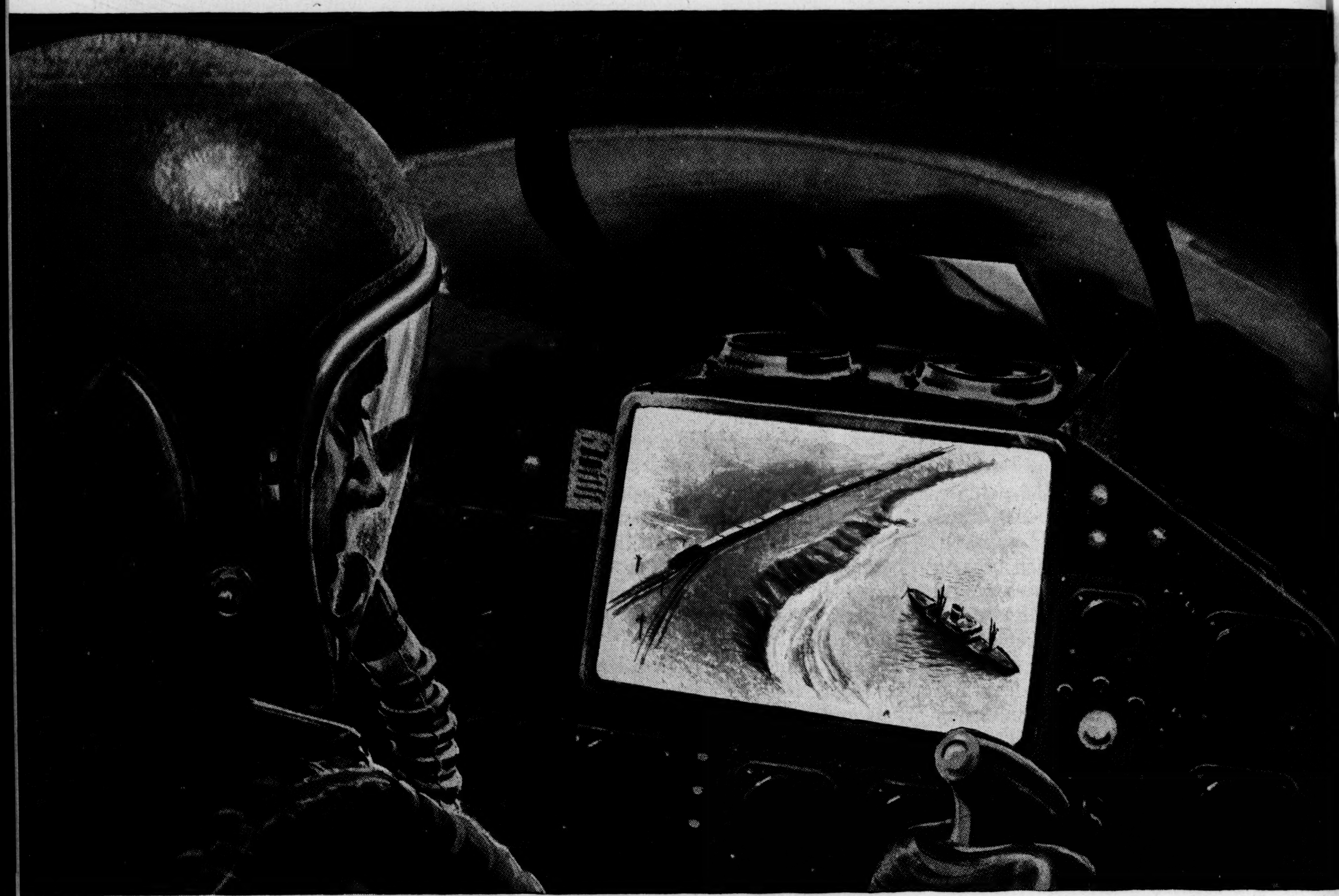
Hughes Aircraft Co. scientists are reported to have achieved power levels of as much as one megawatt in a laser for a brief microsecond. But considerable work remains before the energy level available from optical masers reaches values which would qualify it as a potential weapon by itself, most observers believe.

Additionally there is the problem of attenuation and scatter of optical maser

Satellite Simulator Cushioned on Hydrogen

Simulator for testing of satellite stabilization and control systems, developed by Minneapolis-Honeywell Aeronautical Division, is highly sensitive to applied control forces, virtually isolated from external friction and vibration. Simulator consists of six-foot-diameter platform, supported by 10-in. bearing on cushion of high-pressure hydrogen.

GENERAL
ELECTRIC
LMED
... LEADER IN AERO/SPACE ELECTRONICS



THERMOPLASTIC RECORDER/DISPLAY SYSTEM

Ground-level detail projected to vehicle for immediate use

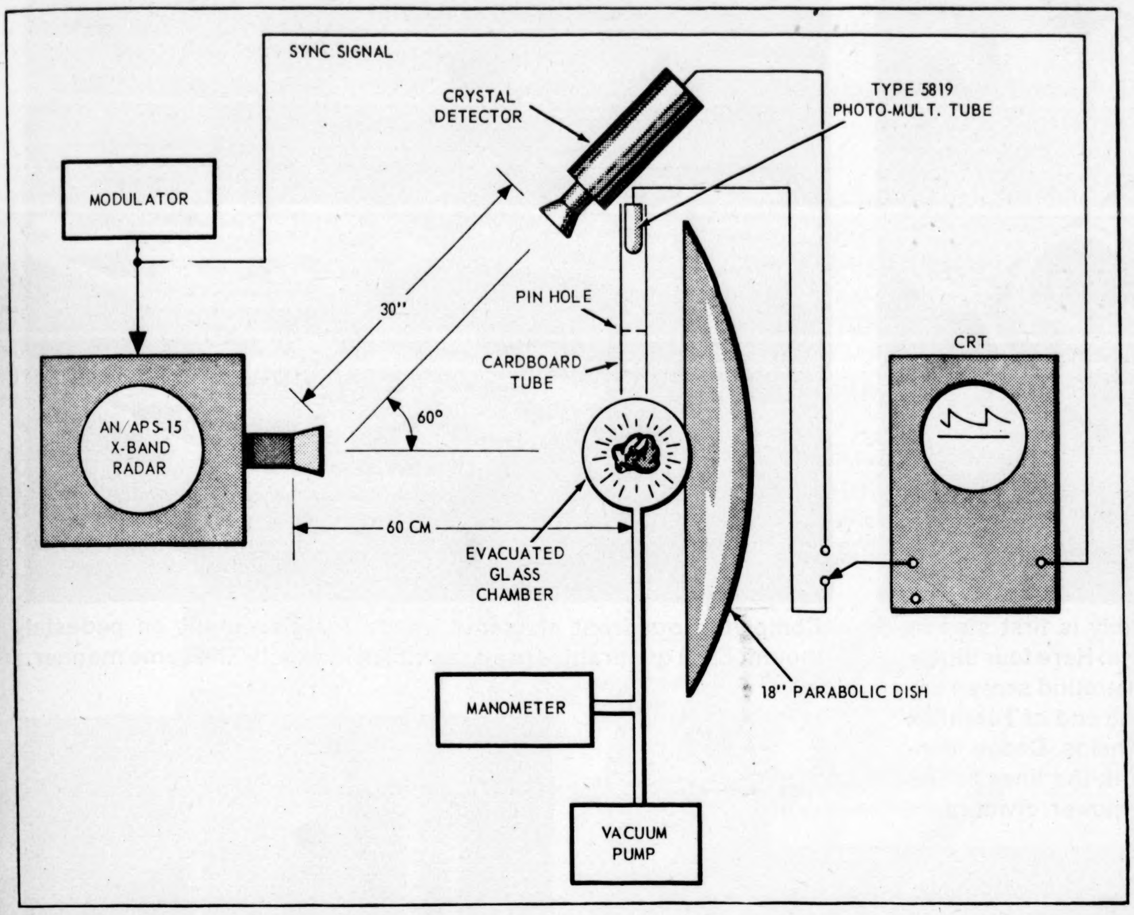
At 40,000 feet and higher a pilot could spot ground-level targets no larger than a tank by using a new recorder/display system developed by General Electric's Light Military Electronics Department. A photographic view is obtained from side-looking radar, recorded on thermoplastic tape, and displayed instantly on a screen in the cockpit. Requiring no cathode ray tube, the screen has variable brightness that permits operation in ambient light, without the use of a hood.

At extreme heights—or in space—the system is capable of providing great detail and a permanent data record of TV, infrared, or any other "eyes" of the vehicle. Combined or composite displays are also possible for integrated display applications. The thermoplastic recorder/display system is a typical example of LMED contributions to progress in aero/space electronics.

150-07

GENERAL ELECTRIC

Light Military Electronics Department
Utica, New York



EXPERIMENTAL ARRANGEMENT used by Bendix Research Laboratories to produce plasma discharge in low-pressure air, employs low-power X-band radar and 18-in. parabolic reflector to focus the microwave energy into partially-evacuated glass chamber.

energy as it passes through the atmosphere. This is particularly severe if the laser output is at infrared wavelengths. If the device were carried by a satellite and operated only in space, this problem is avoided. But this would raise another problem: providing sufficient electric power aboard the satellite.

The general consensus of many observers is that even if it were possible to apply high-level electromagnetic energy directly to an ICBM warhead, there is no assurance that this by itself could destroy or deflect the warhead.

Use of Plasma

Thinking has now shifted to the idea that perhaps the use of microwave energy or radiation from an optical maser could be used in combination with plasmas. A plasma is a collection of neutral and ionized particles and free electrons, with large amounts of energy stored in the internal energy levels of the particles. The arc lamp, used for many years to provide an intense source of illumination, produces this illumination by creating a plasma containing luminous particles vaporized from the electrodes.

For ICBM defense, the plasma might be the one which surrounds, and sometimes precedes, a body re-entering the atmosphere at high speed. If this plasma energy can be harnessed or focused to deflect or destroy the warhead, using external electromagnetic energy provided by ground (or satellite-borne) radar or laser beams, the ICBM defense problem is solved, at least in theory.

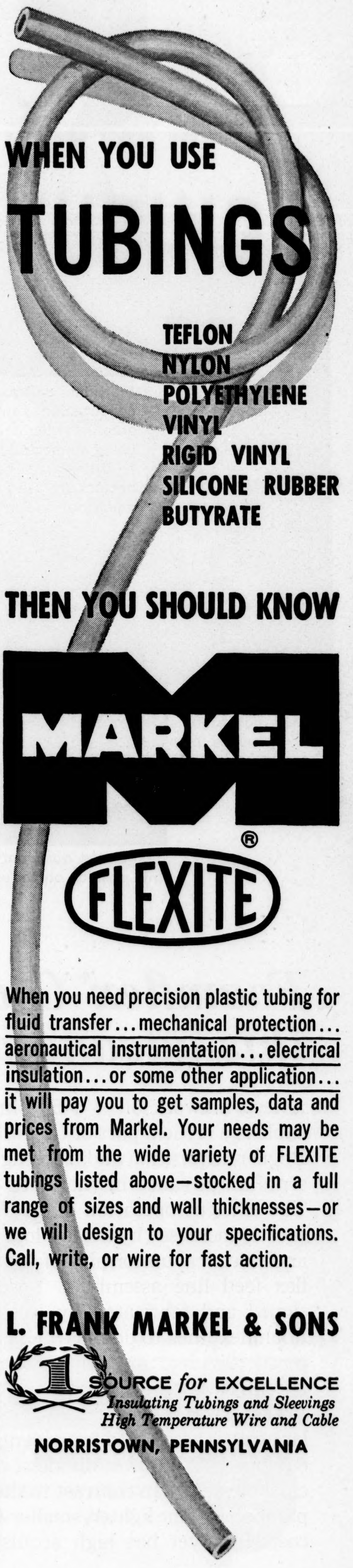
Inasmuch as the warhead itself carries an explosive more than sufficient to destroy the warhead, the question naturally arises whether it could be triggered by external means.

At the recent American Rocket Society meeting in New York, H. S. Glick described a new hypersonic shock tunnel that has been constructed at Cornell Aeronautical Laboratory to study interaction of electromagnetic waves with the plasma sheath surrounding a hypervelocity vehicle. Glick cited communication blackout problems and discrimination between warheads and decoys as subjects which would be investigated by the new facility, with no reference to weaponry. Cornell Aeronautical Laboratory is one of the contractors under Project Defender.

Another means of employing plasma for possible ICBM defense which has aroused the interest of both U. S. and USSR scientists is to use electromagnetic energy to create artificial lightning balls, similar to those which sometimes occur after a thunderstorm. These would be directed at incoming ICBM warheads.

There is extensive evidence in Soviet literature that their scientists have been investigating both natural and man-made lightning balls for some years. In the U. S., scientists at RADC, Bendix and Armour Research Foundation have conducted limited experiments with plasmas produced by electromagnetic radiation.

Another area of exotic weaponry under research investigation in the U. S. involves the possible use of particle accelerators, similar to an ion or


WHEN YOU USE
TUBINGS

TEFLON
NYLON
POLYETHYLENE
VINYL
RIGID VINYL
SILICONE RUBBER
BUTYRATE

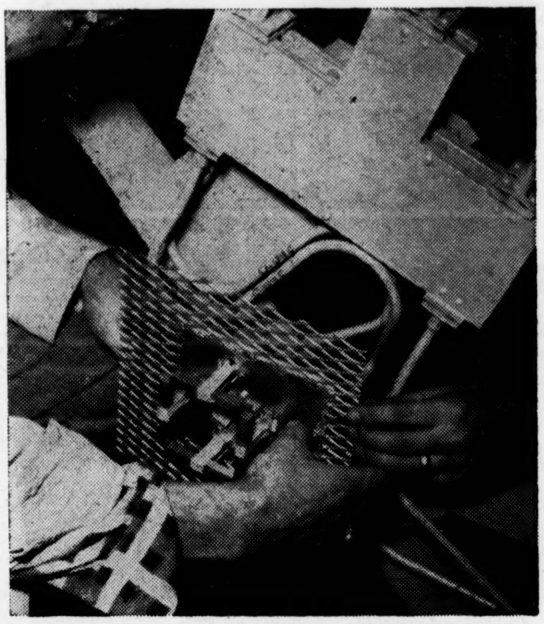
THEN YOU SHOULD KNOW

MARKEL

FLEXITE®

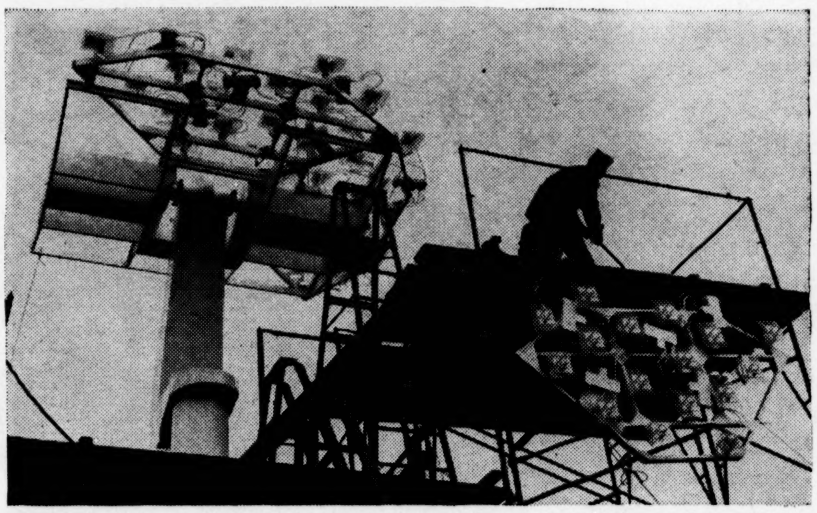
When you need precision plastic tubing for fluid transfer... mechanical protection... aeronautical instrumentation... electrical insulation... or some other application... it will pay you to get samples, data and prices from Markel. Your needs may be met from the wide variety of FLEXITE tubings listed above—stocked in a full range of sizes and wall thicknesses—or we will design to your specifications. Call, write, or wire for fast action.

L. FRANK MARKEL & SONS
1 SOURCE for EXCELLENCE
Insulating Tubings and Sleevings
High Temperature Wire and Cable
NORRISTOWN, PENNSYLVANIA

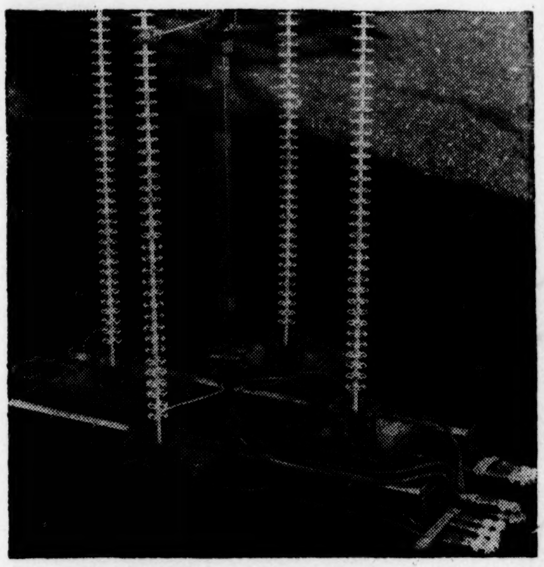


Individual unit assembly is first step in construction of antenna. Here four dipole antennas mounted on ground screen are being connected to one end of Foamflex feed lines. Special Phelps Dodge connectors are used to link the lines to the dipoles and four-way power dividers.

Completed quadrant elements, ready for placement on pedestal mount. Each quadrant is pre-assembled in exactly the same manner.



Completed quadrant elements are raised to platform for placing into position on pedestal mount.



An example of a center element unit that can be inserted into the Avien-Bogner array. This element forms a separate unit that can also be used as a portable ultra high frequency antenna.

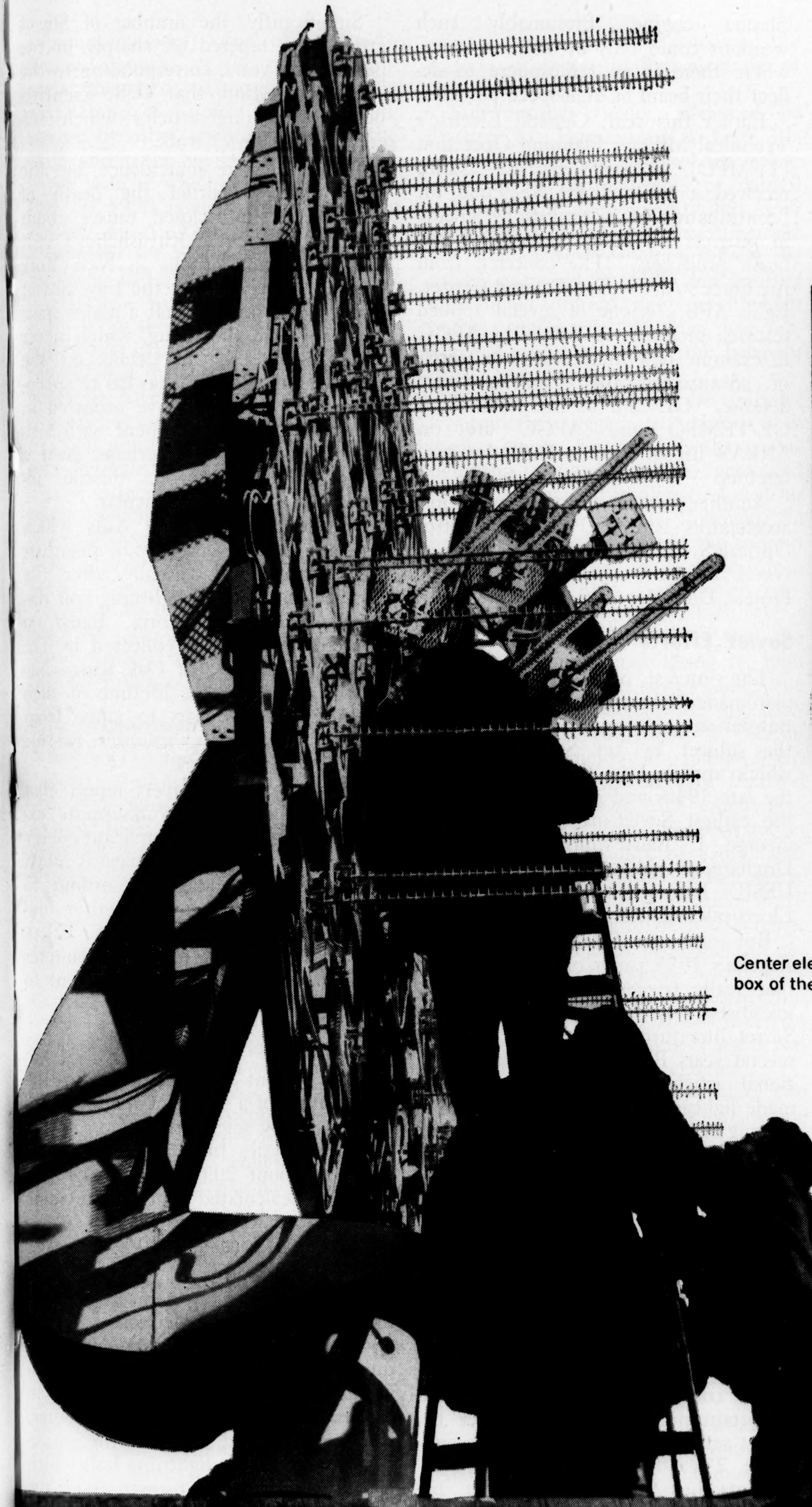
Foamflex® Coaxial Cable helps put and keep this advanced antenna system on the track!

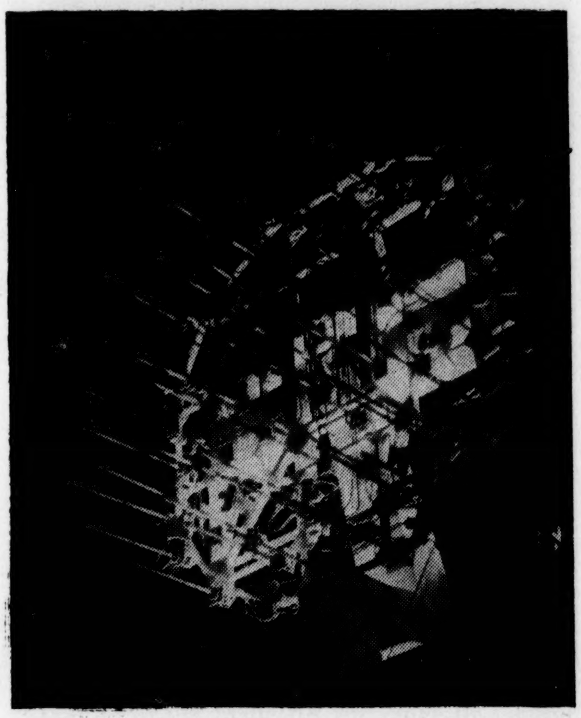
A feed network of 3/8", 50 ohm Foamflex coaxial cable is a critical part of the fully automatic Avien-Bogner acquisition and tracking antenna that represents an advance in the state of the antenna art. The efficient operation of this sensitive antenna is greatly increased by the low loss, high phase stability and electrical uniformity of its weatherproof Foamflex feed line assemblies. Special connectors, designed and fabricated by Phelps Dodge, link the Foamflex lines to double-tuned, strip-line, four-way power dividers in each quadrant element of the antenna.

Designed for Edwards Air Force Base, this modular array is assembled from identical quadrants, each equipped with power dividers, dipole antennas and cigar elements. In contrast to the heavier, fixed-type paraboloids, the lighter, smaller Avien-Bogner model costs less, yet has high acquisition capability for telemetry information through the use of three automatic tracking modes. Quadrant elements may easily be replaced when changes are desired in frequency bands, due to the simple design and construction of this antenna.

The feed system was planned, fabricated, calibrated and installed by A-T Electronics, New Haven, Conn. Accurate uniformity of electrical length for each cable was maintained from cable to cable within one degree at 2200 megacycles after bending.

The outstanding qualities of semi-flexible, aluminum-sheathed Foamflex have been proved in a number of applications where low loss, long operating life and a low noise to high signal level ratio are essential. If your specifications call for a coaxial cable of the highest efficiency, we recommend you investigate the capabilities of Foamflex.





Self-tracking Avien-Bogner acquisition array has capability to telemeter data from vehicles traveling in the far reaches of space.

Center element unit is connected to the junction box of the Avien-Bogner antenna.

PHELPS DODGE COPPER PRODUCTS
CORPORATION
300 Park Avenue, New York 22, N.Y.

P D MINE TO MARKET

Engineered Environment

The caddis worm fashions his water habitat by building about his body a snug house of twigs. It is complete with a filtration system that keeps out silt and predators but lets in food.

With nuclear age hazards, air filtration must play an increasingly prominent role in our weapons projects and in ground control centers. For over a half-century, AAF has dealt with all types of air filtering problems and is recognized as a world leader in "better air." As an example, AAF supplies air filtration systems which protect against chemical, bacteriological and radiological contamination.

AAF equipment designed to military specifications covers the entire field of portable type and facility environmental control. Can our specialized know-how give a boost to *your* project? We invite your inquiry. "Better air is our business."

AAF
PACKAGED ENVIRONMENT
- Heating
- Ventilating
- Air Filtering
- Refrigeration
- Humidity Control

ENGINEERED ENVIRONMENTAL SYSTEMS

DEFENSE PRODUCTS DIVISION
American Air Filter Co., Inc.
310 Third St. • Rock Island, Ill. • Phone 788-9311

plasma engine. Presumably such weapons could only be used in space, where there is no atmosphere to deflect their beam of high-speed particles.

Earlier this year, General Electric's Technical Military Planning Operation (TEMPO), at Santa Barbara, Calif., received a contract for $229,686 for "continuation of investigations already in progress analyzing the uses of ion-beam projectors." The contract, from Air Force's Air Proving Ground Center, Eglin AFB, "is one of several applied research programs sponsored by APGC to examine new mechanisms in search of advanced weapons for aerospace defense," GE said at the time. Both GE-TEMPO and APGC are on ARPA's list of Project Defender contractors.

Another research effort in cesium ion accelerators is under way at Electro-Optical Systems, Inc., under Office of Naval Research contract as part of Project Defender.

Soviet Efforts

The interest of U.S. scientists in man-made lightning balls stems from translations of a number of papers on the subject by key Soviet scientists which appeared in their literature in the late 1940s and mid-1950s. One of the earliest Soviet papers was by Dr. George I. Babat on "Electrodeless Discharges," published in 1947 in the USSR's Journal of the Institution of Electrical Engineers.

But it was Soviet Academician Kapitsa's 1955 paper on ball lightning that really triggered interest of U.S. scientists who were following the Soviet literature at that time. Within several years Babat had authored additional articles speculating that man-made lightning balls, produced by converging beams from ground-based radar, might be used for air defense purposes.

Two of the U.S. scientists whose curiosity was aroused were Dr. Silberg and Donald J. Ritchie, at the time co-workers at Melpar. Silberg subsequently joined Raytheon and Ritchie moved to the Bendix Research Laboratory, Ann Arbor, Mich.

Ritchie is author and compiler of a newly published book "Ball Lightning" which contains translations of seven important articles on the subject by Soviet scientists, including Kapitsa and Babat. The 70-page book also contains an introduction to the subject by Ritchie and an extensively annotated bibliography of 83 important papers by scientists of all nations. "Ball Lightning" is published by Plenum Press, Consultants Bureau Enterprises, 227 West 17th St., New York 11, N. Y.

More than 40% of the articles on ball lightning listed by Ritchie are by Soviet authors.

Significantly, the number of Soviet articles has tapered off sharply in the past several years, corresponding to the approximate time that U.S. scientists began publishing articles which referenced the Soviet work.

It may be mere coincidence, but the Soviet press reported the death of Babat from undisclosed causes about the time of Premier Khrushchev's visit to the United Nations in New York in the fall of 1960. At the time Soviet sources were hinting that a major spectacular was in the offing, which never materialized. Lack of details on the cause of Babat's death has led to speculation that it might have occurred in the course of an experiment with artificial lightning balls, perhaps even a demonstration against a missile, intended as a Soviet spectacular.

The natural lightning balls which have aroused the curiosity of scientists occur infrequently, usually after the more familiar type of lightning bolt discharges in a thunderstorm. Based on reported observations, collected by Dr. J. R. McNally, Jr., of Oak Ridge National Laboratory, the lifetime of such lightning balls appears to range from a few seconds to many minutes, Ritchie reports in his new book.

The fact that observers report that such balls occasionally disappear explosively, suggests that significant energy is stored in the ball, "perhaps as much as one million joules," according to Ritchie. Depending upon whether multiple ionization occurs, Ritchie calculates that a ball one meter in diameter would have stored energy equivalent to between 0.6 and 60 lb. of TNT.

Shock Wave

From recent measurements of the temperature of a stroke of natural lightning made by scientists at the USSR's Lebedev Physics Institute, indicating a figure of about 20,000C, Soviet scientists have calculated that the pressure in the shock wave produced by such a discharge can exceed 1,000 psi. directly ahead of the flash.

To explain the formation of a lightning ball, Soviet Academician Kapitsa postulated in 1955 that the energy required to create the plasma comes from intense radio waves produced by an external source. One possible source, Kapitsa speculated, might be the ionization produced by a lightning bolt which usually precedes the formation of the ball.

Kapitsa suggested that his theory be evaluated in a laboratory experiment using a powerful source of radio waves in the deci-centimeter range, focused into a small space, to attempt to produce an electrodeless discharge. Under these conditions, the discharge "should grow into a luminous ball with a diameter approximately equal to one-fourth the wavelength" of the radiation, Kapitsa theorized. Theories conflicting with those of Kapitsa have been advanced by other scientists, both in the U. S. and in the Soviet Union.

An article which appeared in the Oct. 30, 1960, issue of Komsomol'skaya Pravda, by A. Yur'yev, reported that equipment for producing artificial ball lightning had been developed, using a quartz tube with a special profile and with a heat-resistant non-conducting core which carries electric arcs. "When the thermal dissociation and ionization processes have been completed, the air is suddenly cooled, carrying a luminous fire ball approximately 1 cm. in diameter through the outlet of the tube."

The article concludes with a statement which suggests that the experiment has objectives more important than merely satisfying scientific curiosity: "However, this method is considered to be of only theoretical interest since the over-all efficiency is low, i.e., the consumed energy is much higher than that released during the explosion."

U.S. Experiments

Similar experiments have been carried out in a number of U. S. laboratories, including those at Rome Air Development Center, Armour Research Foundation and Bendix Research Laboratories. Bendix scientists in a company-funded effort used an X-band airborne radar transmitter capable of producing 21 kw. peak power and about 50 watts average power. Using a paraboloid to focus the X-band energy into an evacuated sphere, Bendix scientists produced a free-floating mass of plasma.

However, it did not closely resemble a lightning ball, Ritchie points out, in several important respects. The magnitude of the ionization was much weaker and there were no cohesive forces at work to hold the plasma together, as appears to be the case for natural ball lightning.

A theory that suggests that ball lightning is not a plasma phenomenon has been advanced by E. L. Hill of the University of Minnesota School of Physics. Hill hypothesizes that the ball lightning is a region containing a strongly inhomogeneous distribution of space charge in the form of a highly ionized gas, the ionization being primarily in molecular form, with a few electrons. Hill suggests that occluded material such as dust, water vapor and combustible gases may play a significant role in its behavior.

The previously cited Soviet article by A. Yur'yev explains the explosive disappearance of lightning balls by suggesting that it occurs when the plasma comes in contact with catalyzers, such as oxides of nitrogen, carbon, dust and other substances, which accelerate the transfer of energy to free electrons of the surrounding air.

Still another theory, advanced by Carsten M. Haaland of Armour Research Foundation, suggests that there may be two distinct types of natural lightning ball phenomena. One, with an energy level of less than 0.1 joule per cubic centimeter which follows the model proposed by Hill, and another with higher internal energy level, which behaves differently. Haaland has proposed a model to explain the behavior of the higher energy type.

Haaland's theory, which he concedes is speculative, suggests that plasma with greater energy density than the parent lightning stroke may be generated through magneto-turbulence. Local air turbulence immediately following a lightning stroke could twist the column of negative ions left in its wake into a loop, resulting in a configuration conducive to forming a plasma ball.

The theory also postulates that the ball is prevented from losing its high internal energy to its surroundings due to a buffer zone of cool ions and electrons which is contained by the intense magnetic field of the plasma itself.

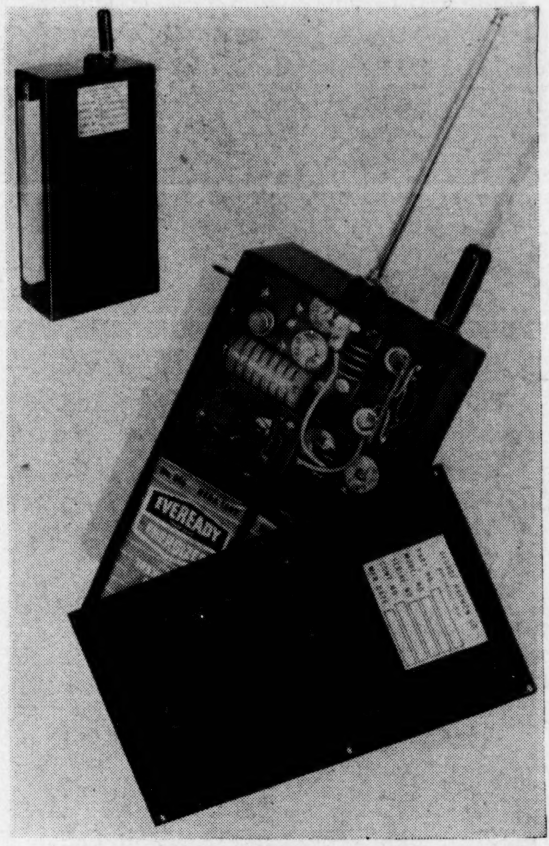
Approximately a year ago, Haaland and his co-workers at ARF sought government support for a program to investigate the feasibility of using radar beams to confine plasma in free space. Ultimate goal was the production of artificial lightning balls for ICBM defense.

The ARF concept proposed the use of electromagnetic waves having suitable orientation of their electric and magnetic field vectors. It was based on previous work in confining charged particles in cavities and waveguides.

If the concept proved feasible, two or four pairs of earth-based radars whose beams converged in space could be used to produce an artificial lightning bolt. By changing the frequency and/or moving the radar beams once the ball had been formed, it should be possible to accelerate the plasma up to relativistic speeds in less than a second, ARF scientists speculated. However, the ARF proposal emphasized that considerable research was required before the feasibility of the concept as an ICBM defense could be determined.

For unknown reasons, the study and experimentation program proposed by ARF did not receive government support, although the amount of funding needed was only about $100,000. Similarly, a Bendix proposal to research the characteristics and applications of free-space microwave-produced discharges has not received government financing. One possible explanation is that similar work was already under way at other facilities.

A simple device which produces doughnut shaped plasmas, called spherical plasmoids, and simultaneously accelerates them to speeds of more than 400,000 mph., has been reported by W. H. Bostick, currently with the Stevens Institute of Technology. The Institute also is a contractor to ARPA on Project Defender.



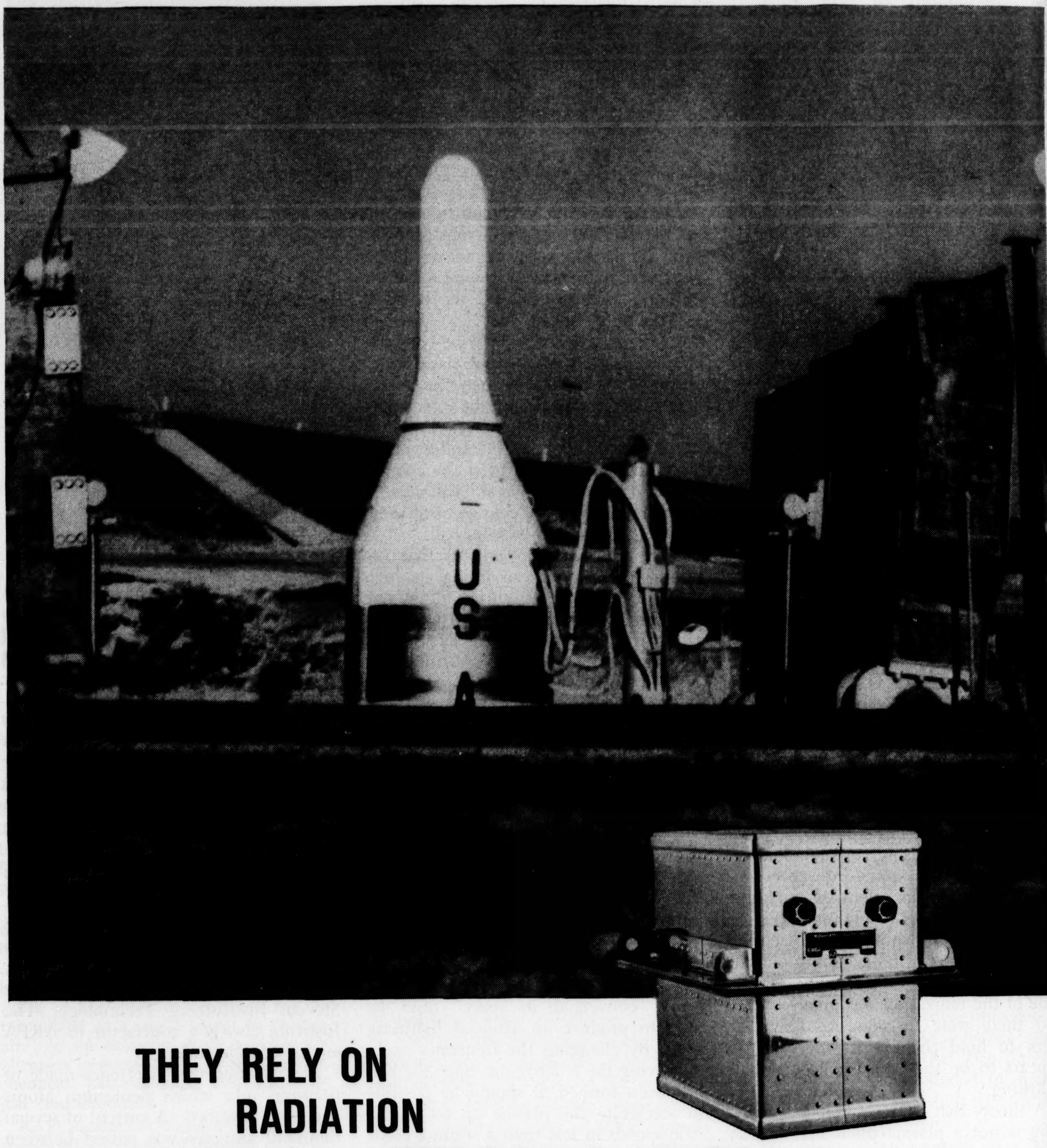
Pilot Locator Beacon

Pilot locator beacon, which automatically transmits emergency signals on the military distress frequency of 243 mc. when a pilot deploys his parachute or pulls an activating plug, is being made for the Navy by George Harmon Co., Inc., Northridge, Calif. Beacon, including battery pack, weighs less than 1 lb., can produce distinctive tone for continuous periods up to 14 hr. over a range up to 100 mi. The sealed unit measures 3 in. x 5½ in. x 1¼ in. and its signals can be picked up by standard UHF receiving equipment.

Bostick used two electrodes made of titanium into which deuterium atoms had been absorbed. A current of several thousand amperes was passed between the electrodes for an interval of about one-half microsecond, equivalent to an energy of about six joules. (This is the amount of electrical energy required to light a six-watt lamp bulb for one second.)

The current discharge causes evaporation of ions and electrons from the electrodes, forming a plasma which is pinched into a slender column by the magnetic field produced by the discharge current. This slender column of plasma bends, breaks loose and forms into a doughnut-shaped blob of plasma which then moves away from the electrode at speeds up to 120 miles per second, Bostick reported.

Another mechanism for rapid ac-



THEY RELY ON RADIATION for proven PCM telemetry in Titan

The recent launching of an Air Force Titan lofted a missileborne PCM telemetry system into space for the first time. Designed and built by Radiation Incorporated, this advanced system also marks another, and more important, first in the telemetry field: Its capability of processing both digital and analog data in a single compact unit weighing less than 21 lbs.

With the spaceborne system, Radiation provides an Input Simulator for pre-launch checks and a Ground Checkout Rack for ground synchronization and decoding. Capability of further combining the spaceborne package with existing Radiation circuitry for low-level signal conditioning makes practical the universal system approach.

Radiation pioneered PCM techniques, and is recognized for many of the significant advances in the state of the art. This fast-growing company offers attractive career opportunities in a broad spectrum of scientific and engineering specialties. All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin. For details on Radiation—and on latest PCM developments—write Dept. AW-121, Radiation Incorporated, Melbourne, Florida.

RADIATION
INCORPORATED

celeration of a plasma was reported a year ago by scientists of Radio Corp. of America at the American Rocket Society meeting in Washington. They reported that a non-uniform RF field with a frequency of 140 mc. had been used to accelerate a plasma "to high velocities for the first time." The RCA experiments confirmed earlier theory that a plasma could be accelerated toward a low-field region when subjected to an RF field oscillating at less than the plasma's critical frequency. Although the authors did not discuss the application of the technique beyond electric propulsion for space vehicles, it appears applicable to accelerating plasmas produced in space by other means. The RCA experiments were sponsored by ARPA through a contract monitored by the Air Force Office of Scientific Research.

The use of radio frequency fields to confine a plasma is one of many possible confinement techniques that has been considered, and investigated, by scientists working on controlled fusion power. General consensus has been that RF containment is not one of the more promising techniques. This was borne out at the recent international controlled fusion power conference at Salzberg, Austria, where there were no papers delivered on the subject of RF containment.

But at the last minute, a British scientist submitted an abstract which briefly outlined some RF containment studies in the United Kingdom. This British abstract triggered a Soviet scientist to report on the USSR's efforts in RF containment. Later, a Soviet representative told an American scientist that the USSR has 125 professional scientists working on RF containment of plasmas.

This has prompted speculation that the Soviet effort may be directed primarily at goals other than controlled fusion power, such as artificial lightning balls.

There are growing indications that the difficult problems of controlled fusion power and plasma weaponry have much in common, and that scientists and organizations engaged in one are likely to be found working in the other. This appears to be confirmed by the list of Project Defender contractors.

Both require greatly increased fundamental knowledge of plasmas. For X-weapons, there is the additional need for knowledge of the working medium—the ionosphere and outer fringes of the earth's atmosphere.

The huge radar now under construction in Puerto Rico, under ARPA funding, has the announced purpose of measuring electron density in the ionosphere and serving as a radio/radar telescope. There is speculation that it may also be used for experimentation in testing theories of lightning ball formation.

Plating of Thin-Line Metal Designs Tested for Microelectronic Wafers

By George Watson

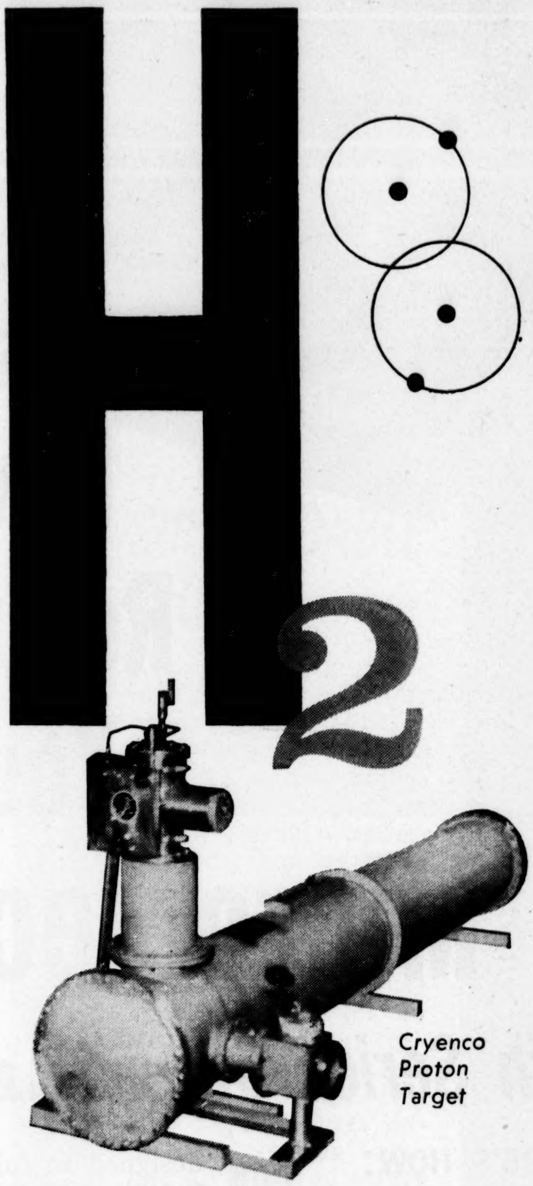
Boston—Techniques for forming extremely thin strips of gold, aluminum or other materials on germanium and silicon with high resolution were described here at the Northeast Electronics Research and Engineering Meeting (NEREM).

The techniques, called scribe- and trace-plating, permit preferential plating of straightline, circular and other patterns on a semiconductor wafer. Application is expected to be in microelectronics, for fabrication of patterns difficult to form by conventional photoresist or mechanical masking methods. Report was authored by W. Rindner and J. M. Lavine of Raytheon.

Other significant advances reported at NEREM include:

- **Generation of optical harmonics** using a high intensity beam of light from a commercial ruby laser. The beam (wavelength 6,943 angstrom units, 0.5 millisecond pulsewidth, intensity 10^8 watts/cm^2 at focal plane) was passed through a red filter and focused inside a quartz crystal. Emergent beam was analyzed by a spectrometer with red-insensitive spectrographic plates; dense images were obtained at the position of the second harmonic (approximately 3,472 angstrom units). Latest achievement is mixing harmonics from two laser sources to obtain beat frequency. Developments were described by G. Weinreich in a report authored by Weinreich, P. A. Franken, A. E. Hill and C. W. Peters of University of Michigan.
- **1,000-ft. spherical reflector antenna** for the Department of Defense Atmospheric Ionic Observatory is scheduled for completion in March, 1962, E. L. Bouche of Air Force Cambridge Research Laboratories stated in a report co-authored by Philip Blacksmith, Jr. Intended for use in radar and radio astronomy investigations, the stationary antenna has a mobile 96 ft. traveling wave array reflector feed, and can scan the sky between declination angles of −2 deg. and 38 deg. North. Transmitter has peak power of 2.5 megawatts at 430 mc.; cw power is 100 kw. The receiver

CRYOGENICS



Cryenco Proton Target

Write us for low temperature, high vacuum equipment to use in your liquid hydrogen work!

- **Hydrogen Liquefiers**
- **Hydrogen Cryostats**
- **Valves and Lines**
- **Liquid Storage and Transport**
- **Refrigerators 20°-30° K**

Liquid hydrogen provides an ideal medium for research in the range of 20°-30° K. Cryenco engineers have pioneered many of the phases of work in this area. Today, these men are available to you for production of equipment and hardware that you need—both standardized and custom built. An example of the background of these men is the fact that Cryenco engineers have worked on all of the major refrigerator-liquefiers used for hydrogen bubble chambers in the free world. A 2,570 watt, 208 liters/hour hydrogen refrigerator-liquefier is now under construction in our plant. Hydrogen dewars and cryostats are being designed and fabricated from small sizes up to railroad tank car capacities. Cryenco men are ready to go to work on your hydrogen equipment problems—free your physicists and engineers for fundamental work. Write for standard equipment catalog, or send us your specific requirements for our quotation.

CRYENCO

Cryogenic Engineering Co.
227 W. 48th Ave., Denver 16, Colo.
Low Temperature, High Vacuum
Equipment and Engineering

Now Reduce Your

This semiconductor network data processor was developed by Texas Instruments Incorporated under the direction of Manufacturing and Electronic Technologies Laboratories, Aeronautical Systems Division, Dayton, Ohio.

Microelectronic Design Time

with Series 51 SOLID CIRCUIT* semiconductor networks

HERE'S HOW:

- designed to fulfill logic functions of complete equipment assemblies—compatible with most of today's logic circuitry.
- low power drain minimizes thermal problems and reduces power supply requirements.
- advanced manufacturing techniques including diffused planar structures, deposited leads, oxide protection, and hermetically sealed package—offer you the potential for improved circuit reliability.
- today's ultimate in microelectronics—with the highest function/size ratio for your digital circuits or equipments.
- provide reduced microelectronic cost through TI's standard silicon wafer design.
- meet military requirements:

Power Drain	2-4 mw @ 3 volts
Fan-Out (TI SN 510, 512, 514, 515)	4
Fan-Out (TI SN 511, 513)	20
Propagation Delay	75 to 450 nsec
Power Supply	3 to 6 volts
Temperature Range	—55° to +125°C

UNIT	TI SN 510	TI SN 511	TI SN 512	TI SN 513	TI SN 514	TI SN 515
FUNCTION	Flip Flop, Counter	Flip Flop with emitter follower output	NOR/NAND Gate (6 input)	NOR/NAND Gate (6 input) with emitter follower output	Two NOR/NAND Gates (3 inputs each)	Exclusive OR
	Clock pulse is internally capacitive-coupled					

CONTACT YOUR NEARBY TI SALES ENGINEER TODAY FOR COMPLETE SPECIFICATIONS AND CUSTOM DESIGN ASSISTANCE.

**Trademark of Texas Instruments Incorporated*

COMPONENTS DIVISION
CAPACITORS, DIODES,
RECTIFIERS, RESISTORS,
SEMICONDUCTOR NETWORKS,
SILICON CONTROLLED RECTIFIERS

TEXAS INSTRUMENTS
INCORPORATED
13500 N. CENTRAL EXPRESSWAY
P. O. BOX 5012 • DALLAS 22, TEXAS

18686

has a system noise figure of less than 3 db. The antenna, under construction in a remote part of Puerto Rico, will be used initially to measure electron densities, electron temperatures and magnetic field strengths in the ionosphere; later, to investigate interactions of hydromagnetic energy and solar matter with ionosphere, and for study of the moon surface. Venus, Mars, Mercury and Jupiter are expected to be within radar range of the antenna.

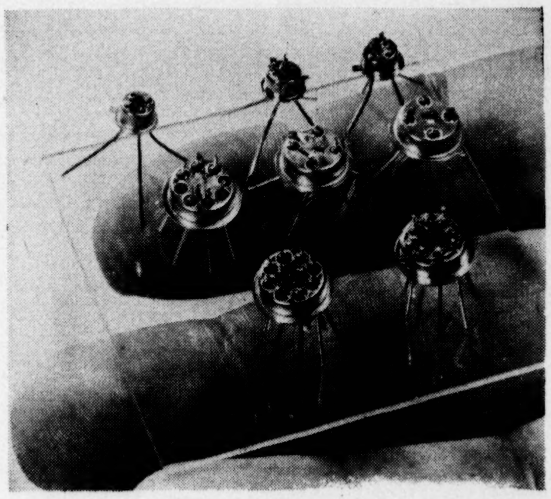
- **Semiconductor microwave control** devices—limiters, duplexers, switches, phase shifters and voltage variable attenuators—consisting of variable capacitance and variable resistance semiconductor junctions were described by Robert Tenenholtz of Microwave Associates, Inc., in a report written by Tenenholtz, Lawrence Gould and Melvin Bloom. Microwave power limiter holds output power constant at approximately 0.1 watts over wide range of input power (on the order of 1 watt to 1,000 watts), peaking to approximately 0.2 watts below 1 watt input. Limiter has been operated at peak power as high as 10 kw. and average power of 100 watts. Duplexer incorporates two limiters between two 3 db. couplers, has a recovery time on the order of nanoseconds, and isolation of 50 to 60 db., with power handling capability about double that of the individual limiters.
- **Electromagnetic amplifying lens,** latest of the microwave cross-field devices which have evolved from the magnetron, was described by W. C. Brown of Raytheon. The tube is designed for quasi-optical handling of input excitation and output radiation at high power levels, with amplifying section interposed. The device is expected to handle average power levels in the megawatt range, Brown said.

In the scribe-plating process, a line is scribed on the semiconductor material with a diamond or steel stylus. The semiconductor is immersed in gold electroplating solution (other metals and electrodeless plating have also been used); the gold plates preferentially on the scribed regions. Scribe plating has been used to fabricate electrodes in diodes and transistors, and semiconductor resistor elements. Because scribing damages semiconductor material to a depth of about one micron, it is not completely successful for devices having thin active regions, such as mesa transistors. Gold strips as thin as one micron have been formed by scribe-plating. Thin parallel lines with a density of 15,000 per inch have been scribed; however, Raytheon does not know if such closely spaced lines can be plated with sufficient resolution.

In trace-plating, a stylus containing a soft metal, usually aluminum, is moved over the semiconductor material, leaving a thin layer which serves as a nucleation center for subsequent plating. A special pointed stylus consisting of aluminum wire embedded in plastic, with matched hardness so that both wear down simultaneously, eliminates the problem of trace widening which would occur if an all-aluminum pointed stylus were used.

Gold lines as thin as 1 micron have been trace-plated. Although the method lacks the definition of scribe-plating, trace-plating does not damage the semiconductor material, and therefore is suitable for devices having thin active regions at the surface. Trace-plating has been used to make mesa transistors with "good performance characteristics," Rindner said. Because two metals are used (one for the trace, another for plating), the technique is convenient when a combination of metals is needed for doping or alloying purposes. Trace plating is also suitable for forming lines where frequent, closely-spaced discontinuities are desired. An array of squares, for example, has been made by tracing parallel lines and removing the trace at regular intervals before plating.

Trace-plating can be used on insulating substrates such as glass and silicon oxides, and therefore has potential for fabrication of thin film circuits and surface-passivated solid state circuits.



Multi-Element Devices

Microelectronic devices with more than one semiconductor situated on multi-lead transistor headers illustrate variety of device combinations, circuits and microelectronic approaches now being marketed by the Microelectronics Department of Philco's Lansdale Division. Typical of company's multi-element devices—several separate semiconductor elements mounted on single headers—are from left to right, rear row, three silicon diodes with common cathode, three silicon diodes with common anode and germanium full-wave bridge rectifier. Each of these is on TO-18 header. In center row, left to right, on TO-5 headers are germanium twin transistor pack for flip-flop circuitry, germanium transistor-diode clamp and germanium full-wave bridge rectifier. Front left is transistor-diode logic pack, and thin film NOR logic pack, which includes sputtered passive components, is right.

RPI space age support provides . . .

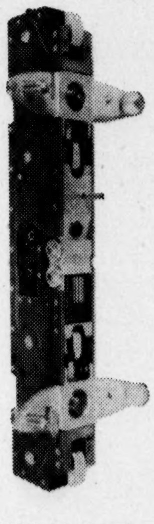
NEW UNIVERSAL EJECTOR RACK

. . . handles any

SUSPENDABLE STORE

Cut costs and installation problems with this unique Rocket Power "all purpose" rack, the MAU12/A, first to handle so wide a variety of stores—special weapons, missiles, conventional bombs, camera pods, and auxiliary tanks.

Developed for the U. S. Air Force Special Weapons Center for use on several Fighter-bombers, Bombers and V/STOL aircraft, this RPI rack features *adjustable* ejection force and all required safety devices. It is easily attached to the aircraft and provides both 14" and 30" hook spacing.



FOR TECHNICAL DATA on the RPI Universal Ejector Rack write for Bulletin #1500.

ROCKET POWER INC.

FALCON FIELD/MESA, ARIZONA

OFFICES: Pasadena/Dayton/Washington, D.C.

TO THE EDGE OF SPACE...

AND BACK

Northrop's Q-Ball, "hot nose" for the X-15, provides flight angle data to the pilot during the critical exit and entry phases of the history-making flights to the edge of space. This permits him to correct his angles of attack and sideslip to avoid the intense frictional heat limits. Q-Ball was developed by the Nortronics Division of Northrop under contract to the National Aeronautics and Space Administration. **NORTHROP**

AN ACHIEVEMENT IN DEFENSE ELECTRONICS

New Transportable Radar Directs Precision Air Support

Front-line ground forces can now obtain all-weather, close air support, —when and where needed—with the new lightweight AN/TPQ-10. This is the first helicopter-transportable, high-accuracy control radar for precision air support. Developed for the U. S. Marine Corps by General Electric's Heavy Military Electronics Department, the versatile new system can also provide aircraft control for emergency supply airdrops, paratroop placements and aerial mapping.

176-07

HEAVY MILITARY ELECTRONICS DEPARTMENT
DEFENSE ELECTRONICS DIVISION • SYRACUSE, NEW YORK

Progress Is Our Most Important Product

GENERAL ELECTRIC

FILTER CENTER

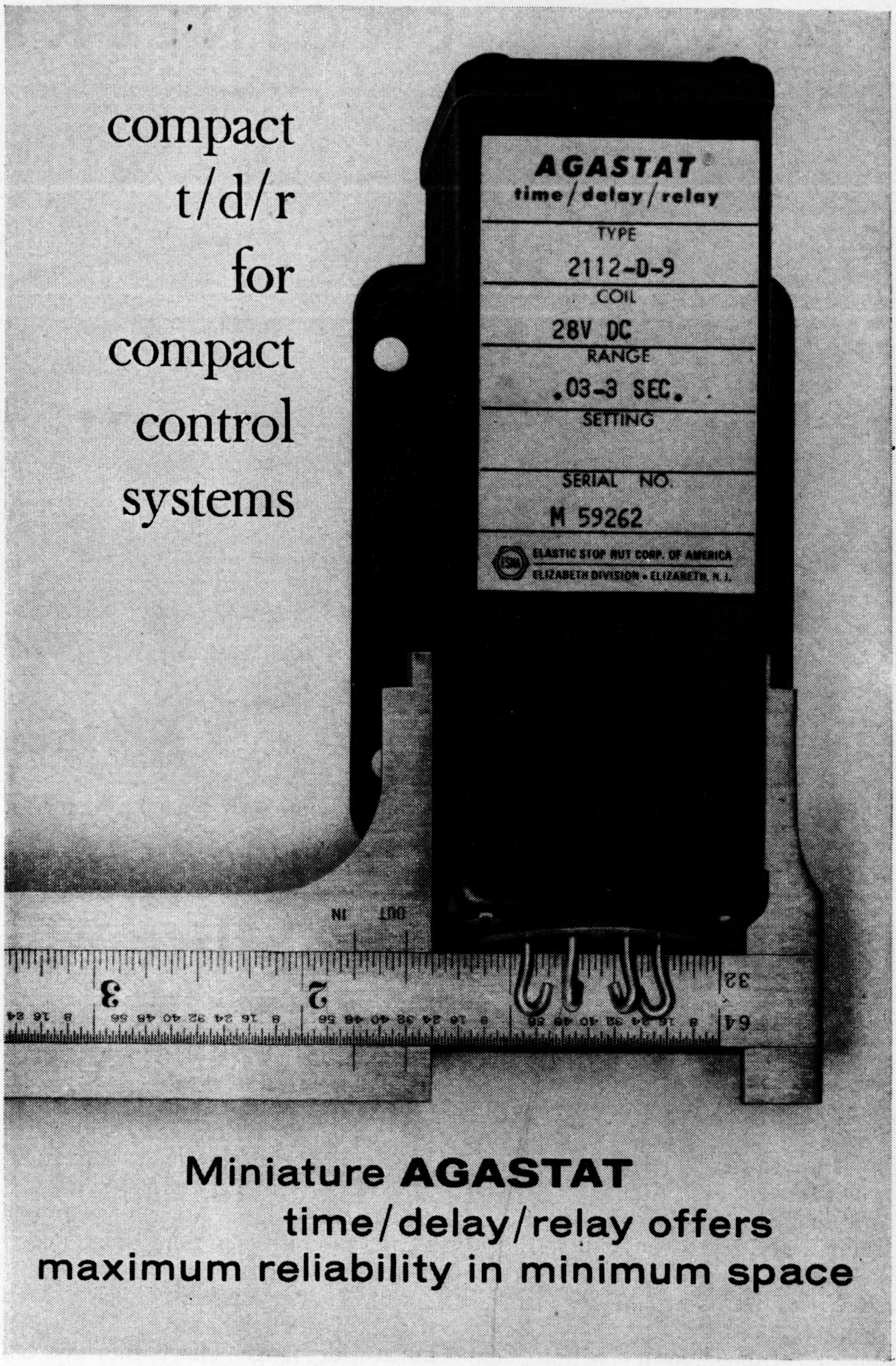
▶ **Radio Propagation Course Scheduled**—National Bureau of Standards course in radio propagation will be given at its Boulder (Colo.) Laboratories, July 16 through Aug. 3. Course is open to scientific personnel in industry, universities and government agencies.

▶ **New Thermoelectric Material Developed**—A germanium-silicon alloy, which has exhibited conversion efficiency of 9% and is expected to reach 15%, has been developed by Radio Corporation of America. New thermoelectric material appears best suited for operation in the temperature range of 550C to 1,000C, but can be operated at temperatures up to 1,800C, company says.

▶ **NAA Expands PERT Use**—North American Aviation's Space and Information Systems Division will use PERT (Program Evaluation and Review Technique) for all major contracted and inhouse programs, company has announced. First use of PERT will be on the Saturn S-II booster program for National Aeronautics and Space Administration. Company also will use PERT "as a basic planning, evaluation and control system for all future major development projects," it says.

▶ **High Temperature Piezoelectric Crystal Developed**—Process for treating quartz crystal which enables it to oscillate with great stability at temperatures as high as 550C has been developed by Bell Telephone Laboratory. By subjecting quartz crystal to an electric field of about 500 v. per centimeter for a period of 24 hr. at a temperature of 500C, impurities are swept out of the crystal, enabling it to subsequently oscillate with little energy dissipation at temperatures of 550C, BTL reports. When crystal wafers are cut from treated blocks at angles of rotation greater than 38 degrees, the crystal exhibits extremely stable oscillator characteristics, BTL says.

▶ **USSR Studies Piezoelectric Polymers**—Recent Soviet literature suggests the possibility of producing new type of piezoelectric material using polymers such as polyorthofluorostyrene, polyorthomethystyrene, polypropylene and polyoxymethylene by subjecting solidifying melt of fusible polymers to a constant electric field. Writing in July-August, 1961, issue of Kristallografiya, I. S. Rez speculates that certain substances may be found with a variety of combinations of piezoelectric, ferroelectric, pseudo-ferromagnetic and semiconductor properties.



For control systems where reliability *and* size are important design considerations, specify the Miniature AGASTAT time/delay/relay.

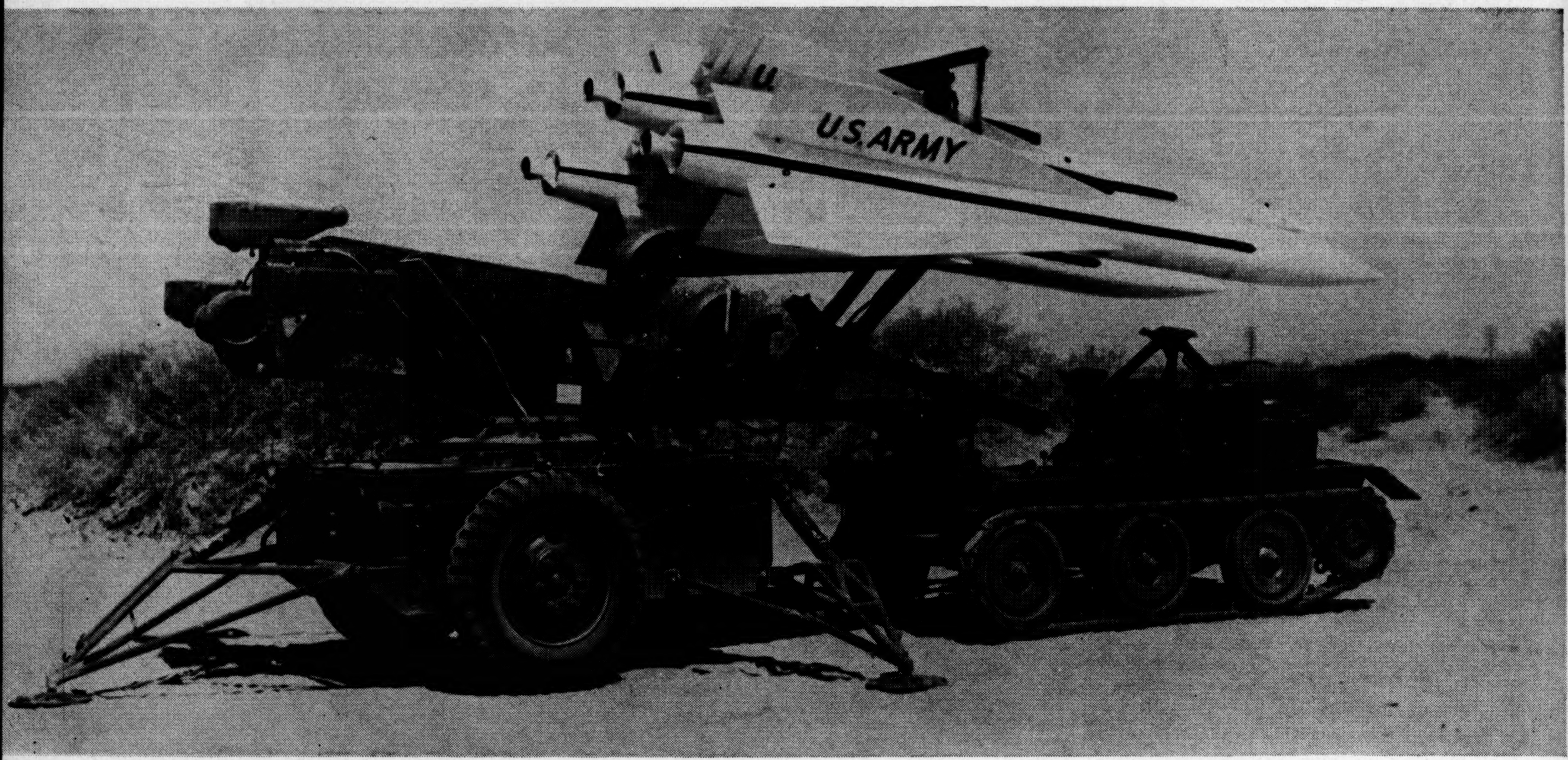
Only 1½ in. square, less than 5 in. high, and weighs as little as 15 oz. Four adjustable models provide delays from .03 sec. to 3 minutes—on pull-in or drop-out. Electrically-operated, pneumatically timed for instant recycling and freedom from voltage-variation drift. Choice of ac and dc operating voltages, with solder lug, octal plug or AN connector terminals.

Since 1931, AGASTAT time/delay/relays have been specified for reliability and accuracy in almost every industry with electrical control requirements. Wouldn't this be a good time to learn what this proven performance can mean in your timing circuit?

We'll gladly send complete details. Just write Dept. M2-112

AGASTAT® TIMING INSTRUMENTS
ELASTIC STOP NUT CORPORATION OF AMERICA
ELIZABETH DIVISION ■ ELIZABETH, NEW JERSEY

IN CANADA: ESNA CANADA, LTD., 12 GOWER ST., TORONTO 16, ONTARIO, CANADA



THREE HAWK MISSILES are carried to launcher and loaded, ready for firing, by tracked loader/transporter vehicle.

Army Hawk Anti-Aircraft Missile—Part I:

Rapid Tactical Mobility Stressed in Hawk

By David A. Anderton

Andover, Mass.—Army's Hawk anti-aircraft missile system, developed and in high-volume production at Raytheon Co., is well into its second year of service with 13 Army battalions deployed in West Germany, the Panama Canal Zone and the island of Okinawa in the Pacific.

U. S. Marine Corps fielded its first Hawk systems more than a year ago, using a "stripped-down" battery concept that makes all components air-transportable by helicopter.

Within the coming months, five NATO countries—West Germany, Italy, France, Belgium and Holland—will activate a total of 22 battalions among them.

Hawk—which conveniently is an acronym for Homing All-the-Way Killer—is being developed and produced under a prime contract between Army's Boston Ordnance District and Raytheon Co. The Northrop Corp. is the single major subcontractor; but the system draws on components manufactured by about 3,500 active suppliers.

Technical direction of the program is the job of Army Rocket and Guided Missile Agency, working with Raytheon's Missile and Space Div. at Bedford, Mass.

First exclusive details and photographs of the Hawk system at a field level are presented here; a second article will describe production of the weapon system at Raytheon's Aero/Weapons division.

Primary mission of the Hawk system is defense against low-flying attack aircraft. Past thinking has generally bracketed this task in terms of subsonic planes and altitudes from ground level to about 1,000 ft.

But Hawk capabilities have been stated by military sources to cover a much wider range. Hawk, they say, can engage targets flying at speeds up to Mach 2 at altitudes from ground level to 50,000 ft. They point to successful intercepts by Hawk of tactical missiles—Honest John, Little John, and Corporal—to emphasize the quick response of the Hawk system, even when the target is supersonic and has a small radar cross-section. Little John, for example, is just over one foot in diameter.

Typical targets knocked out by Hawk during test firings in the missile development program included an XQ-5 drone—hit at a speed of 1,400 mph. above 30,000 ft.—and a QF-80 drone, engaged at less than 100 ft. altitude.

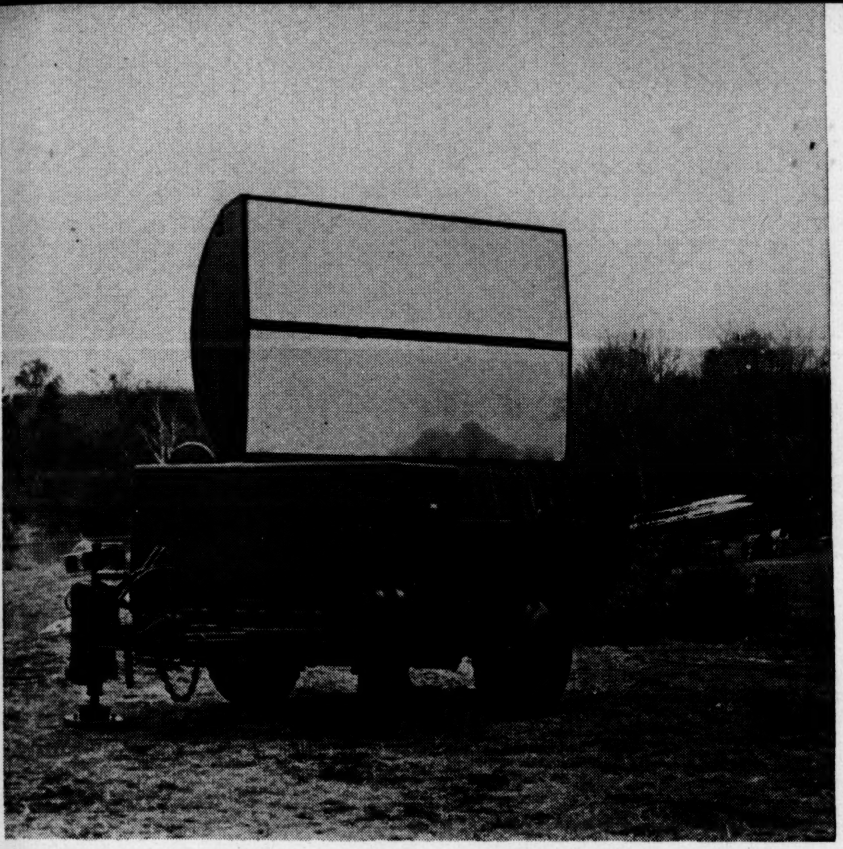
Major characteristic of the system is its ability to maintain a high rate of fire against single, massed or widely separated targets.

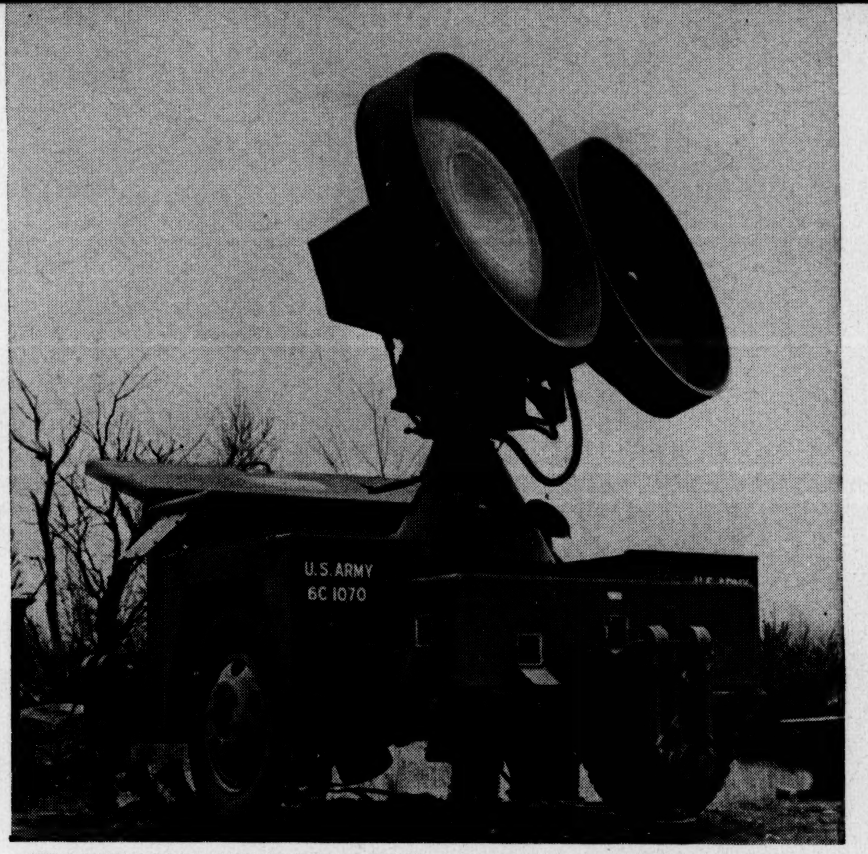
The low-altitude capability of Hawk originally led to Army plans to use it as a weapon complementary to Nike-Hercules for area defense. Hawk would engage low-flying attackers, while Nike-Hercules would take on the high-altitude targets. But the Joint Chiefs of Staff rejected the idea early in 1959, and since then there has been no work on fixed-site installations for Hawk.

Instead, Hawk is a field-army weapon, designed to be rapidly and easily transportable by a variety of current cargo aircraft, helicopters or wheeled vehicles. It can be set up anywhere that provides line-of-sight between its radar and the missiles on their launchers. No prepared sites are necessary, and the only preparation—once the battery has rolled into position—is to level the various trailers and lay the cables connecting power supply to the components of the firing sections.

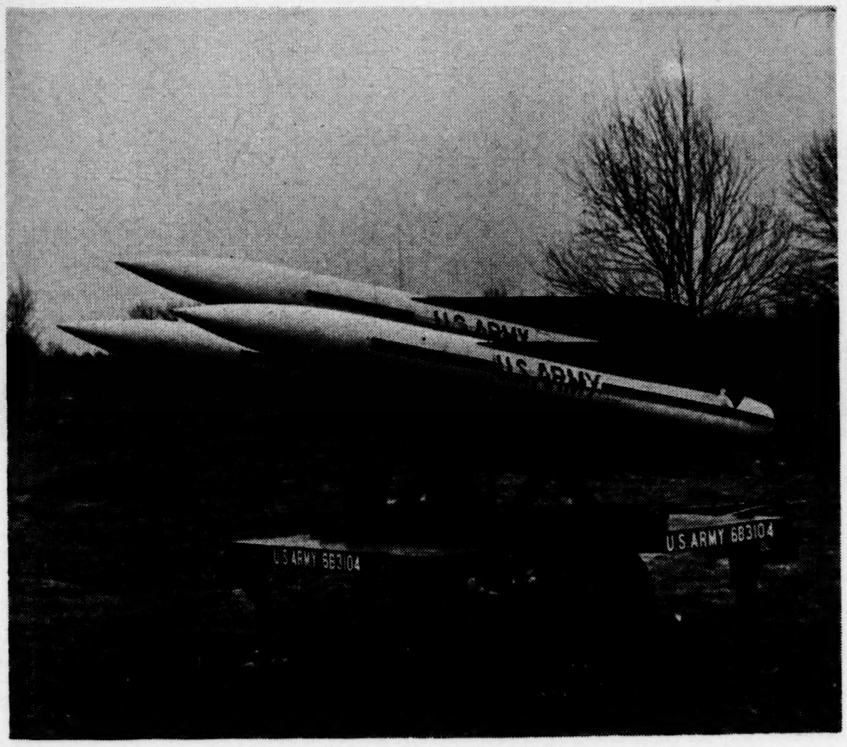
Each Hawk battery consists of two firing sections commanded from a single battery control central station. The battery has two acquisition radars. One of them, the AN/MPQ-35 pulse acquisition radar, gives coverage of long-range, high-altitude and large-volume targets. The other is an AN/MPQ-34 cw acquisition radar, for picking up targets practically at treetop level.

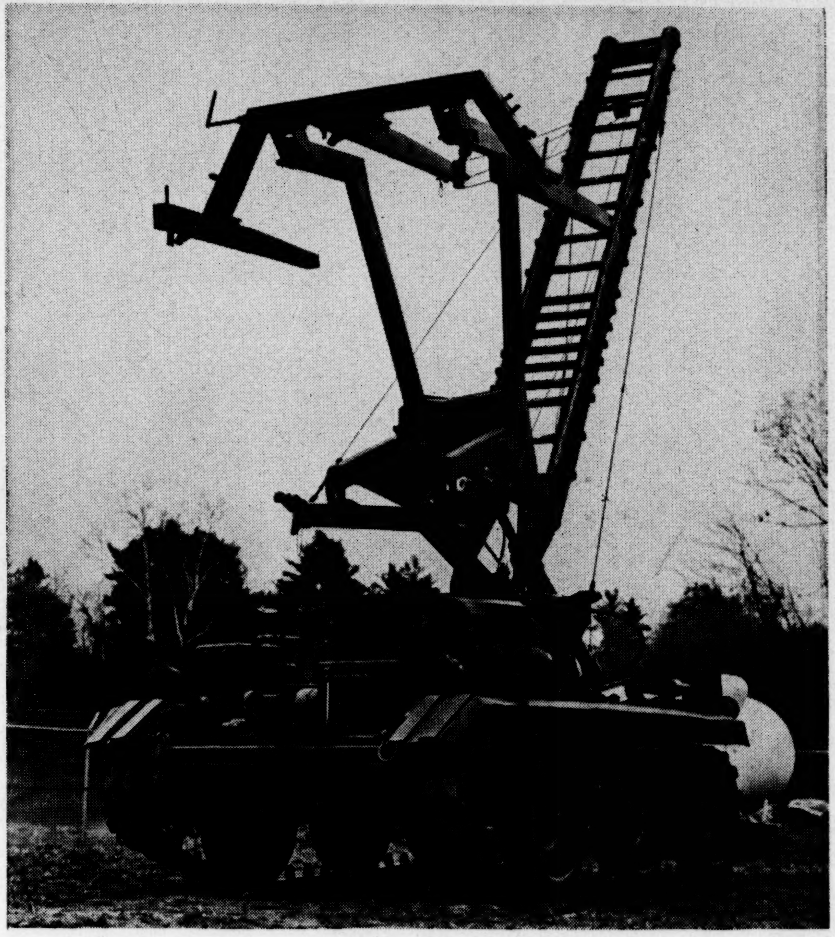
Both these radars feed target information to the battery control central, where targets are identified and selected for action from a conventional plan-





HAWK battery equipment includes AN/MPQ-34 cw acquisition radar (above) and AN/MPQ-33 cw illuminator radar (upper right). Three Hawk missiles, ready for transport as a unit to launcher, are mounted on pallet attached to wheeled trailer (below). Crane beam has been added to loader (lower right).





position indicator (PPI) presentation. Each of the firing sections is tied to battery control through its AN/MPQ-33 cw illuminator radar, which receives a target azimuth from battery control and then searches in an elevation box to find and lock on the target. After lock-on, the search procedure continues automatically.

Each firing section has three launchers, each pre-loaded with three Hawk missiles. The battery control central receives information as a display which tells the status of each missile. Battery control then selects the missile to go. The missile looks at its target, which is illuminated by the cw radar, and also looks at the illuminator radiation for reference.

When the target is in range, the section operator in the battery control central fires the Hawk. Its internal guidance system solves the intercept equation during the flight out and directs the missile to the strike.

Normal operations of the Hawk system are under the direction of five men, once the site has been readied. These five, stationed in the battery control central, include the tactical control officer and his assistant, who work from a situation presentation and a plan-position indicator display of the local area.

Crew Functions

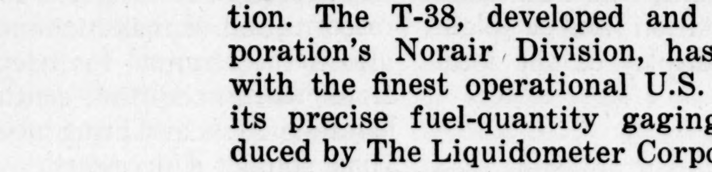
These men identify and select targets for the missile system.

The cw acquisition radar, which picks up low-flying targets while ruling out returns from ground clutter and slow-moving traffic, is operated by a third man. The two remaining men sit at two consoles, one for each firing section, and observe target displays. They finally fire the Hawks when the marked target comes within striking range.

Tied into the control system is the crew chief distribution box, which interrupts the lines between the cw illuminator radars of each firing section and the Hawk launchers. The crew chief can use this box to remove any launcher in his section from action for reloading or correction of malfunctions. This box also is the terminal for telephone lines from battery control central so that handling crews and firing crews can have voice contact if necessary.

Basic complement of the battery just described is five officers and 68 men; that organization is the one being used by U. S. Army Hawk units. But the Marines, with a different emphasis on use of the weapon during an assault operation, have chosen to operate a "stripped-down" Hawk system that is completely transportable by helicopter. This basic choice rules out the larger

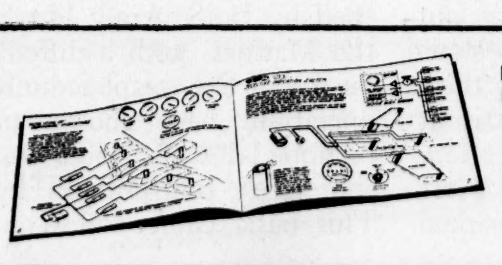
NORTHROP DUAL-COCKPIT T-38 TALON



LIQUIDOMETER T-38 FUEL GAGING SYSTEM uses capacitor type tank units to feed master indicator in one cockpit. Repeater indicator duplicates information in second cockpit. T-38 uses two of these systems.

Fastest way to train free world's pilots

THE U.S. AIR FORCE has added an important new step to its supersonic jet training program. With the twin-jet, dual-cockpit T-38 Talon, U.S. pilots are now taught to handle a supersonic aircraft as soon as they complete primary instruction. The T-38, developed and produced by Northrop Corporation's Norair Division, has many features in common with the finest operational U.S. jet fighters. Among them is its precise fuel-quantity gaging system designed and produced by The Liquidometer Corporation, for 35 years a leading supplier of instrumentation to the aircraft industry.



FREE
IDEA BOOK
has 43 diagrams and illustrations on aircraft fuel gaging systems. Write today.

THE LIQUIDOMETER CORP.
DEPT. T, LONG ISLAND CITY 1, NEW YORK

components of the system, such as the battery control central, in favor of smaller and lighter units.

Heart of the Marine system is the AN/TSW-4 assault fire command console, a 450-lb. case that can be brought to the site by helicopter and manhandled into final position if necessary. This unit functions as the battery control central. But because this is a stripped-down system, the Marine Hawk batteries do not have the large pulse acquisition radar; instead, they work with the cw acquisition unit and radar, a single cw illuminator and a single firing section of three launchers.

Even this system can be reduced one step further by eliminating the acquisition radar on the assumption that there will be no need to go looking for targets —they'll be there. For this minimum assault weapon, a single launcher is tied to the assault fire command console through the crew chief distribution box and a single cw illuminator radar.

Hawk batteries which will enter service with NATO countries will use a table of organization like that of the Army batteries. One of the major criteria for the NATO Hawk system is that all components be completely interchangeable with those for the U. S. Army system, so that logistics and operations within the NATO areas are simplified.

System Design

Fundamental requirement for Hawk design, other than those criteria determined by the enemy threat, was that the entire system had to be quickly and easily transportable in existing road and airborne vehicles. This meant that everything had to be sized to minimum dimensions and weights, yet still be consistent with the Army's concept of field operations. Both Army and Marines specified that major wheeled units had to be able to float. For the Army, over-the-road means fording rivers as well. For the Marines, as one officer said, "If everything else fails, we want to be able to put a man on the launcher and have him paddle the thing ashore!"

Further requirements for the Hawk system were determined by Army policy on field maintenance. There is neither the time nor the place to perform any repair work, however simple, on system components in the field, says the Army. Therefore, basic circuits in operational and checkout gear had to be boxed in small, light modules that could be freed from their chassis by a quarter-turn of a handle, pulled out and replaced with a new unit within seconds.

Environmental Stresses

Army field operations imply rugged terrain ranging from deserts through rain forests to Arctic tundra and polar icecaps. This range of environmental conditions imposes the expected requirements on a weapon system designed for Army use. Hawk is expected to take the same kinds of environment as a hand weapon or a half-tracked vehicle.

The missiles are expected to work after being bounced behind prime movers during movements over open terrain, soaked with water while crossing a river or dropped off a moving truck at an advance supply point. After they enter the logistics pipeline, Hawk rounds may sit out in open storage without any extra protection; they may get rained on, covered with snow, pounded with hailstones or abraded by wind-driven sand. But when they go from there to the launchers for pre-flight check, they are expected to work. This also poses design problems.

Basic element of the system is the Hawk missile, a dart-shaped vehicle 198 in. (16 ft. 6 in.) long. The 14-in. diameter body mounts a cruciform of four

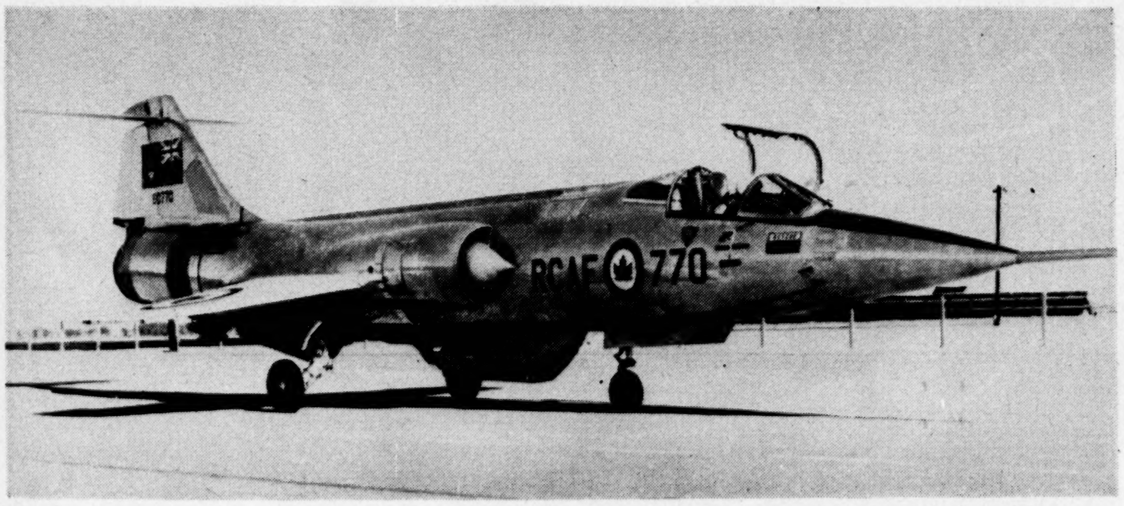


Photo-Reconnaissance Pod Installed on CF-104

Prototype of a photo-reconnaissance pod is installed on a Royal Canadian Air Force Lockheed CF-104 for flight tests at Palmdale, Calif., of aerodynamic compatibility of pod and fighter. Pod contains a prototype VICOM 70-mm. reconnaissance camera system developed by Computing Devices of Canada, Ottawa, and W. Vinten, Ltd., London, England. System is designed for low-level, high-speed reconnaissance.

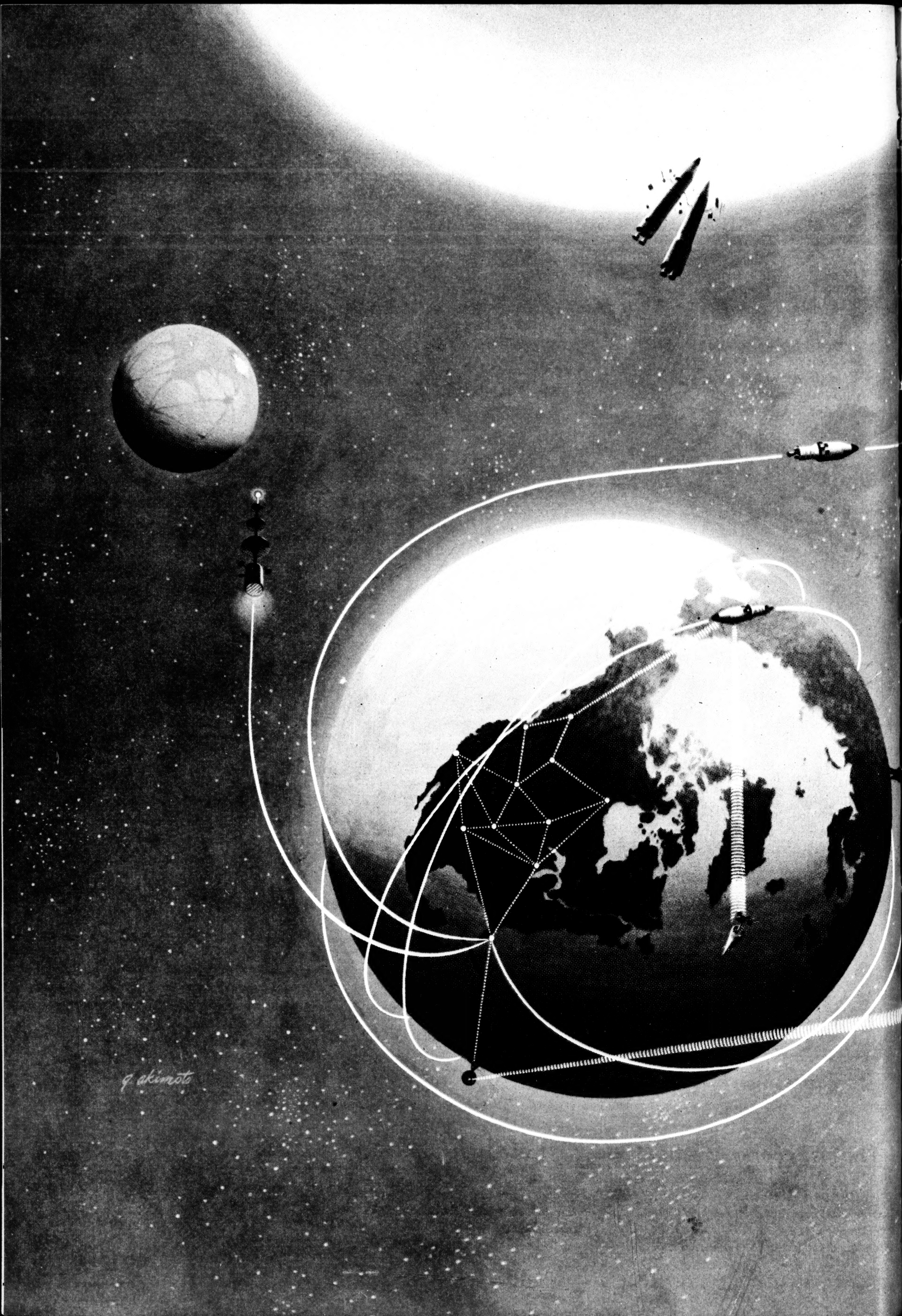
"Testing"
with 7,000 sq ft
of facilities at
Barber-Colman

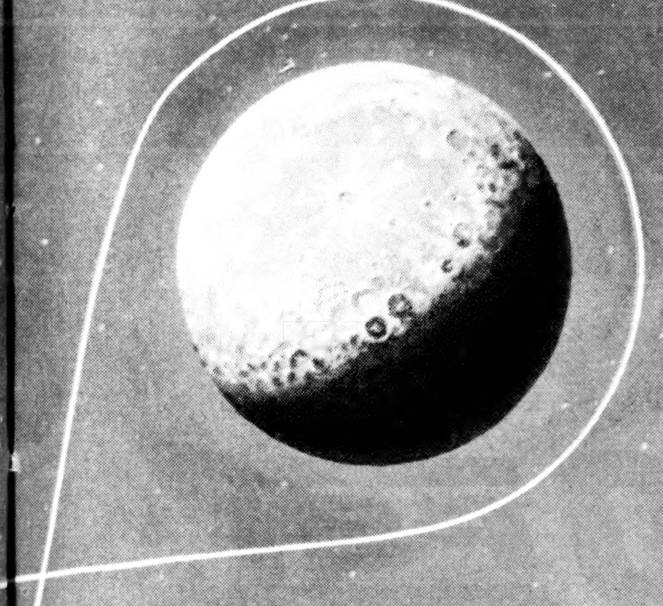
...important part in the Barber-Colman concept of "total engineering for maximum practicality and reliability."

THE MARK OF QUALITY
BARBER COLMAN

From basic idea creation to the finished product . . . *all* aspects of the customer's problem are given complete attention at Barber-Colman. Testing operations, such as pictured here, join development . . . design . . . application . . . and production engineering in the hands of highly experienced men who know what to look for — and how to achieve it — for highly practical, reliable design. For information on how you may put this kind of engineering to work on your aircraft or missile accessories and subsystems (electromechanical actuators, air valves, temperature controls, positioning systems), consult the Barber-Colman engineering sales office nearest you: Baltimore, Boston, Dayton, Fort Worth, Los Angeles, Montreal, New York, Rockford, San Diego, Seattle, Winter Park, Florida.

BARBER-COLMAN COMPANY
Aircraft and Missile Products Division
Dept. X, 1422 Rock St., Rockford, Illinois


g. akimoto



SATELLITE AND SPACE SYSTEMS SPECIALISTS

Here at Lockheed Missiles and Space Company, satellites and spacecraft are a specialty. From research to the reaches of space, the whole scope of space technology is being carefully investigated.

All aspects of research, systems analysis, design, development and operation are handled by outstanding engineers and scientists at Lockheed's Research Laboratories in Palo Alto, and in the development headquarters in nearby Sunnyvale, California.

Typical of Lockheed's complete capability is the DISCOVERER series. This, with its recoverable capsule, is used to gather research material. Other military and commercial satellites and spacecraft under study, under development, or in operation, include:

An infrared missile defense alarm system • Sophisticated orbiting biomedical capsules • Lunar probes • Interplanetary exploration programs
A space rendezvous system • Nuclear and other advanced propulsion systems
Communications satellite systems.

It is clear that the projects at Lockheed Missiles and Space Company are challenging. Moreover, its location on the beautiful San Francisco Peninsula adds gracious living and perfect climate to the many rewarding opportunities available to creative engineers and scientists.

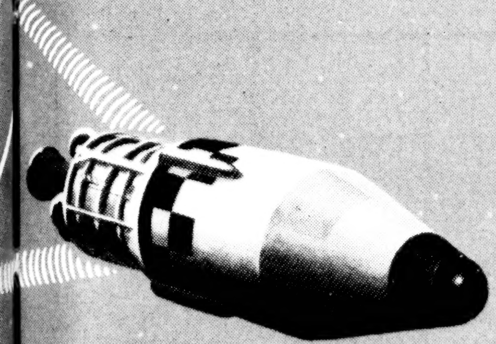
For further information, please write: Research and Development Staff, Dept. M-32A, 962 West El Camino Real, Sunnyvale, California.
U. S. citizenship or existing Department of Defense industrial security clearance required. All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

LOCKHEED MISSILES & SPACE COMPANY

A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

Systems Manager for the Navy POLARIS FBM and the Air Force AGENA Satellite in the DISCOVERER and MIDAS programs. Other current programs include SAINT, ADVENT and such NASA projects as OGO, OAO, ECHO, and NIMBUS.

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA • CAPE CANAVERAL, FLORIDA • HAWAII



NEW FROM ALLEGHENY LUDLUM

MAR-AGING STEELS

WITH YIELDS OVER 250,000 PSI

PLUS TOUGHNESS

Want "special" properties . . . even in the special steels? Then take a look at the Mar-Aging Steels. This brand new group of age-hardening steels for the aircraft and missile industries now offers the strength of the best contemporary steels *plus* toughness!

A few interesting properties: yield strengths exceeding 250,000 psi . . . notched tensile strengths over 400,000 psi . . . and the ability to maintain ductile characteristics below —80F.

Developed from an International Nickel Company discovery, A-L's Mar-Aging Steels are remarkably resistant to crack propagation, easily machinable, easy to weld, and possess unusually low work-hardening tendencies.

Together with the famous A-L stainless steels, and high temperature steels and alloys, the Mar-Aging Steels are available in all product forms, either air melted or vacuum melted. A-L's Mar-Aging Steels . . . just another part of the world's most comprehensive product line for the aerospace industries.

NOMINAL COMPOSITION

	C	Ni	Co	Mo	Ti	Al	Cb
AL 25 Ni (250)	.01	25	. .	. .	1.4	.2	.5
AL 20 Ni (250)	.01	20	. .	. .	1.4	.2	.5
AL 18 Ni Co Mo (250)	.01	18	7	5	.4	.1	. .
AL 18 Ni Co Mo (300)	.01	18	9	5	.6	.1	. .

TYPICAL MECHANICAL PROPERTIES

PRODUCTS	.2 YS (X 1000 psi)	UTS (X 1000 psi)	Elong. %	RA %	Notch TS Smooth TS
BARS (Heat treated)					
AL 25 Ni (250)	250	265	12	50	1.1
AL 20 Ni (250)	250	265	12	55	1.3
AL 18 Ni Co Mo (250)	250	265	10	50	1.5
AL 18 Ni Co Mo (300)	300	305	12	55	1.4
SHEETS (Cold rolled and aged)					
AL 25 Ni (250)	250	270	5	. .	.7
AL 20 Ni (250)	260	270	4	. .	.7
AL 18 Ni Co Mo (250)	285	290	4	. .	.9
AL 18 Ni Co Mo (300)	300	310	3	. .	.8

NEW A-L LITERATURE—A new Data Sheet on Mar-Aging steels is yours for the asking. And be sure to get the set of booklets on A-L's High Temperature Alloys, too. Contact your local A-L Office, or write: Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa. Address Dept. AW-M6.

ALLEGHENY LUDLUM

PIONEERING on the Horizons of Steel

3085

truncated-delta aerodynamic surfaces, spanning 47.4 in. Weight of the complete missile, ready to fire, is approximately 1,295 lb.

A glass fiber radome of ogival shape forms the nose contour of the Hawk. Directly aft of the radome is a cylindrical section containing the entire guidance package and the auxiliary power units. The seeker dish is mounted at the forward end of this package and extends into the base of the radome.

The warhead compartment is located behind the guidance section. Field units have a choice of warheads depending on the expected threat.

Rocket Powerplant

Fuselage space from the leading edge of the wings to the end of the tail cone is filled by an Aerojet-General XM-22E8 solid-propellant rocket encased in a thin-walled shell made of 4130 steel. The rocket engine uses two different propellants to provide two thrust levels for the missile. The boost phase delivers a high thrust for a short duration to accelerate the missile clear of the launcher and to flight speed as rapidly as possible. The sustainer then takes over and provides a lower thrust level until burnout or intercept.

Wings of the Hawk are double-wedge section surfaces, built from all-aluminum alloy honeycomb structural components, skin and fittings. The wing skin is formed from 0.051-in. 7075-T6 aluminum alloy and bonded to the internal structure consisting of two sheet metal ribs, two 0.003-in. foil honeycomb cores and some machined fittings. Three rivets are used. The wings and elevons are being delivered by Ling-Temco-Vought and Northrop, through the latter company which is Raytheon's only major subcontractor.

Control actuators and elevons are mounted in a small ring structure around the necked-down section of the rocket motor nozzle.

Raytheon production here turns out the guidance section, complete with nose cone and elevon control ring. These units are shipped in a standard container (XM417E2) to go either to a field unit as a repair part or to the Raytheon assembly site at the Army's Red River Arsenal, Texarkana, Tex. At this site—designated HAMCO for Hawk Assembly and Missile Check-Out—the complete Hawk round is assembled with its Aerojet-General motor, the LTV-Northrop wings, and the government-furnished warhead. After a checkout, the missile is disassembled and transferred to the XM430 shipping and storage container for shipping either to a storage area or a tactical site.

Parallel to this movement of the missiles themselves, the various items of supporting equipment are sent to Ft. Bliss, Tex., where they are checked out as a system at a Raytheon site. From there, the Army takes over and ships them to a field user.

At the tactical site, a Hawk round is removed from its container to a handling dolly. Assembly of the wings follows. From there, the complete round goes to a check-out area, where 45 min. of testing certifies it as either a go or a no-go round. From there, the missile can be sent either to a pallet for storage or a launcher for ready status.

The XM1E1 pallet is a simple trusswork structure that holds three missiles in the same position as the launcher holds them. The pallet can be used trailer- or truck-mounted, or stand free. Attachment points can be used for pickup gear or for helicopter sling attachments.

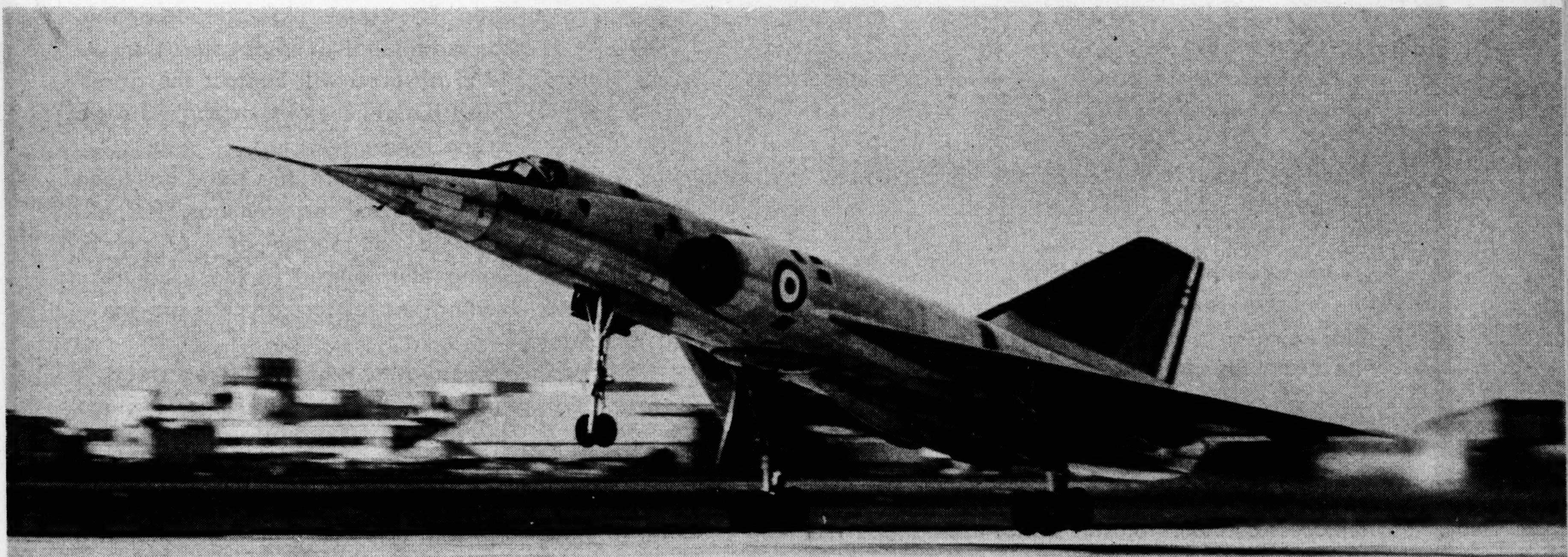
Three tracked XM501-E2 loader-transporter vehicles are assigned to each battery. These units can carry from one to three missiles from checkout and storage areas to the launcher, and load the rounds in a matter of seconds after arrival at the launcher.

The XM-78E3 zero-length launcher is a wheeled, trailer-mounted unit that can be towed behind one of the six M36 cargo trucks assigned to each battery. An electronic control system in the launcher slaves it to the cw illuminator radar for initial pointing before final data is fed to the missile just prior to launching.

Mobile Radars

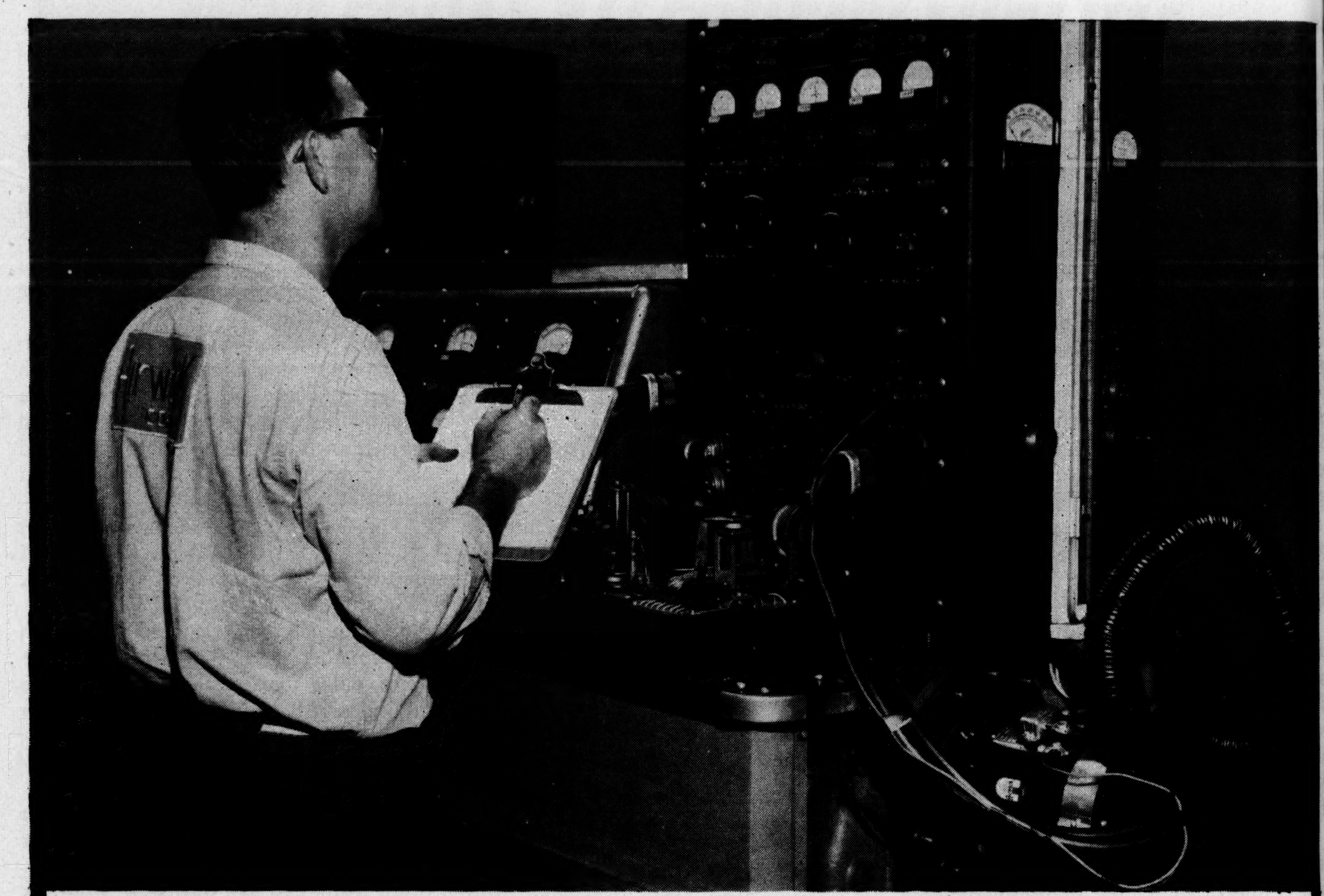
The big pulse acquisition radar, over the unit weight limit for helicopter transport, is palletized so that the electronic unit can be separated from its trailer and air-lifted under a helicopter. The paraboloid reflector breaks down into five pieces for transport.

The smaller and lighter cw acquisition radar is transported as one unit on its two-wheeled trailer. Like the pulse acquisition radar, it can be towed be-



Second Mirage IV Prototype Makes First Flight

First photo of Dassault Mirage IV-02 strategic bomber shows the second Mirage IV prototype on its first flight. The aircraft is identical to the Mirage IV-01 which first flew in mid-1959. France expects to spend about $200 million for 50 Mirage IVs; the air force expects to have them operational by 1965. The two-place bomber is powered by two Snecma Atar 9 afterburning turbojets delivering about 13,500 lb. thrust each. The aircraft gross weight is 50,000 lb. and is designed to carry nuclear payloads of 1,500-2,200 lb. at more than Mach 2. Navigation radome is visible on belly, forward of weapons installation.



WOULD YOU GET A BETTER GENERATOR —IF IT WAS NOT SHOP TESTED?

Yes . . . if it is tested on the stand used by many overhaul shops! The generator overheats . . . the insulation weakens . . . potential trouble-free hours are robbed from the unit *by standard procedures.*

No . . . if it is tested on this Airwork modified stand. That black hose in the lower right carries forced cooling air to the field coils; provides the same volume of air the generator would get if it was operating on your engine under normal flying conditions. This holds the interior temperature within safe limits — keeps the insulation fresh — preserves the long operating life built into the generator by careful Airwork overhaul procedures. A thermocouple attached to the housing makes sure the operating temperature stays safe.

Even with all these safeguards, Airwork eliminates unnecessary hours on the stand. Most shops "run-in" the brushes from 7 to 12 hours so they wear to fit the armature. Even after 12 hours, many brushes have only a 50% contact area. This causes high-altitude arcing.

Airwork uses an additional overhaul step that assures 90% of the brush area will contact the armature *before* test. Then the generator is motorized for a short film-forming run before final test.

Like most of our test equipment, this stand has been redesigned to meet Airwork requirements. For example, it records field coil output at four points, instead of averaging their output at the usual two. The additional readings makes sure all coils are working properly.

Even before the generator went on the test stand, it went through many Airwork extras, such as 2-plane dynamic balancing of the armature that eliminates a vibrating load from the brush rigging.

Every Airwork engine and accessory goes through a lot of extra steps that add up to greater reliability in service. In the long run, an Airwork overhaul saves you money, time and trouble.

ESSENTIAL SERVICES
TO AVIATION

Airwork
CORPORATION
Millville, New Jersey

hind an M36 prime mover vehicle.

Finally, the cw illuminator radar—which is recognized easily by its two circular antennas—is also a single unit, mounted on a two-wheeled trailer.

The AN/TSW-2 battery control central is a single shelter containing all the monitoring, plotting and fire control equipment. It is within the helicopter weight-lifting limits.

Power supply for the entire battery comes from three trailer-mounted 45kw. electrical generators. A fourth unit supplies power for the missile test and check-out area; a fifth generator is held as a spare. Two crew chief distribution boxes and 31 sets of electrical cable assemblies make up the rest of the power supply system.

Finally, a towable, trailer-mounted AN/MSM-43 organizational maintenance shop goes along with each battery.

Part of the Hawk missile system not attached to the batteries at the field sites is a series of field maintenance shops, normally transported on a flatbed M36 truck to an ammunition supply point or a field-maintenance depot. Each shop is geared to one specialized form of maintenance on the system.

Ready to roll, the Hawk battery makes up into a convoy of 23 vehicles which carry system components for two firing sections equipped with a total of 36 missiles. Over-all system packaging and transport has been planned so that the sections can be ready for firing within minutes after arriving at the battery site.

(This is the first of two articles on the Hawk missile system. The second will appear in a subsequent issue of Aviation Week.)

PRODUCTION BRIEFING

Farina Corp. of Newton, Mass., will construct a 21,000-sq.-ft. Gaseous Physics Research Building for USAF's Cambridge Research Laboratories at Hanscom Field near Bedford, Mass., under a $636,150 contract. The facility, scheduled for completion in October, 1962, will accommodate production and diagnosis of plasma, and interaction experiments.

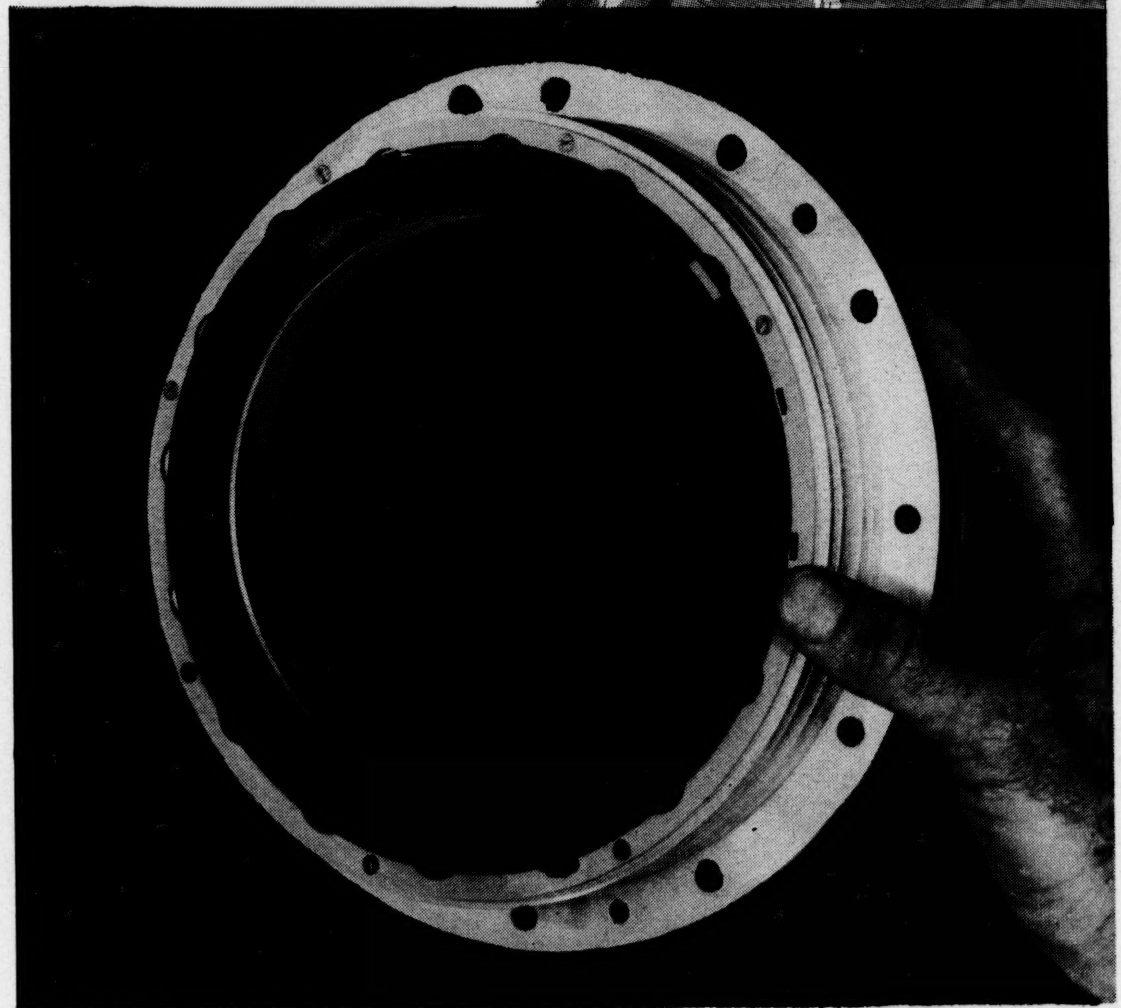
Lockheed P3V-1 Orion flew 2,540 mi. from Burbank, Calif., to Norfolk, Va., in 5 hr. 44 min. with virtually no help from tail winds. Average speed was 441 mph. The plane landed with enough fuel to continue in the air several hours. Flight was made at 23,000 ft. altitude by Lockheed Test Pilot John Christiansen. Plane averaged 412 mph. against headwinds on the return trip. Elapsed flight time was 6 hr. 8 min.

(Continued on page 87)

Now...Borg-Warner Mechanical Seals for Airborne Applications

Developed especially to meet the reliability requirements of airborne components, this new Borg-Warner Mechanical Seal combines compact size with lightweight metallurgy. Entirely new—yet this same basic design has been proved in almost every type of industrial and military shaft sealing job.

Borg-Warner Mechanical Seals are used daily under high pressures, for high or ultra-low temperatures, to seal toxic, corrosive and volatile liquids, and even for radioactive fluids. *Whatever your needs for sealing a rotating shaft, call Borg-Warner Mechanical Seals.*



Typical operating conditions — rocket engine fuel pump at 7450 rpm and 250°F.

Borg-Warner®

Mechanical Seals

B-W

DIVISION OF BORG-WARNER CORPORATION

P.O. Box 2017, Terminal Annex, Los Angeles 54, California

SEE OUR FILE IN SWEETS DESIGN CATALOG – SECTION 8e

Knowmanship in Action

Using hot gas to control
SPACE VEHICLES

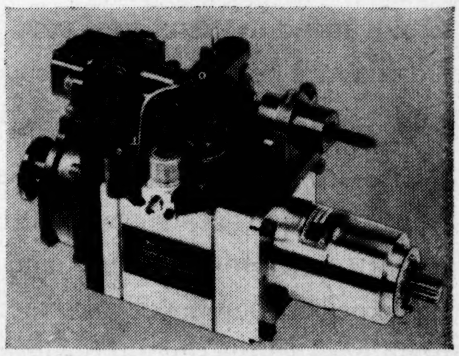
Designers can look to full-gas and electro-gas techniques for special advantages in space and re-entry vehicle control. Chief benefits: resistance to the elevated temperatures of re-entry and to the gamma heating and radiation of nuclear propulsion.

Our research shows that—properly applied—pneumatic or gas controls can operate for long periods at the extreme temperatures associated with re-entry. Also, inherent radiation-resistance makes extensive shielding of the control system unnecessary when used with nuclear engines.

Increased simplicity and reliability also accrue because hot gas uses the propellant energy—**in a single conversion**—to control. This results in a significant weight reduction, too.

E-P concepts now under development aim at expanding the scope of hot gas technology into total space vehicle control. Already under construction for the USAF's Flight Control Laboratory, Aeronautical Systems Division, is a complete Hot Gas Flight Stabilization System. This system employs rotary actuation, reaction jets, central gas generation, gas gyros and pneumatic computation, and is capable of operating for long periods at an ambient temperature of 1400°F.

We will be pleased to demonstrate the feasibility of hot gas techniques as applied to your system requirements. Write us at Teterboro, N. J.



The Bendix® Rotary Pneumatic Servo provides a degree of dynamic stiffness unattainable with previous pneumatic techniques.

BENDIX COUNTDOWN FOR SPACE: ❼ Pneumatic Controls; ❻ Self-adaptive Control System; ❺ Satellite Control and Stabilization; ❹ Star Tracker System; ❸ Spacecraft Rendezvous Computer; ❷ Advanced Displays and Controls; ❶ Letdown, Approach, Landing.

Eclipse-Pioneer Division

THE Bendix CORPORATION

New Advances in Direct Conversion of Heat to Electricity

New advances in the direct conversion of heat to electricity, having important practical applications, are resulting from major development programs now in progress at General Atomic Division of General Dynamics in San Diego, California.

These programs include the development of compact, low-cost thermoelectric and thermionic devices for a variety of industrial and communications purposes, as well as advanced systems for space vehicle auxiliary power. Devices are being built which use solar and chemical heat sources, in addition to those using nuclear energy.

In addition to opening up new technological applications, these programs have also created unusual career opportunities for engineers and scientists with outstanding experience in the development of new products. These openings include several positions which are available for men having extensive backgrounds in both devices and materials.

Inquiries Invited from Engineers and Scientists

Inquiries concerning positions are invited from creative mechanical and electrical engineers, physicists, metallurgists and chemists interested in such fields as: high vacuum technology, the development of insulators, semiconductor-conductor bonds, thermoelectric materials fabrication, high-temperature semiconductors, and the production of thermoelectric converters and generators.

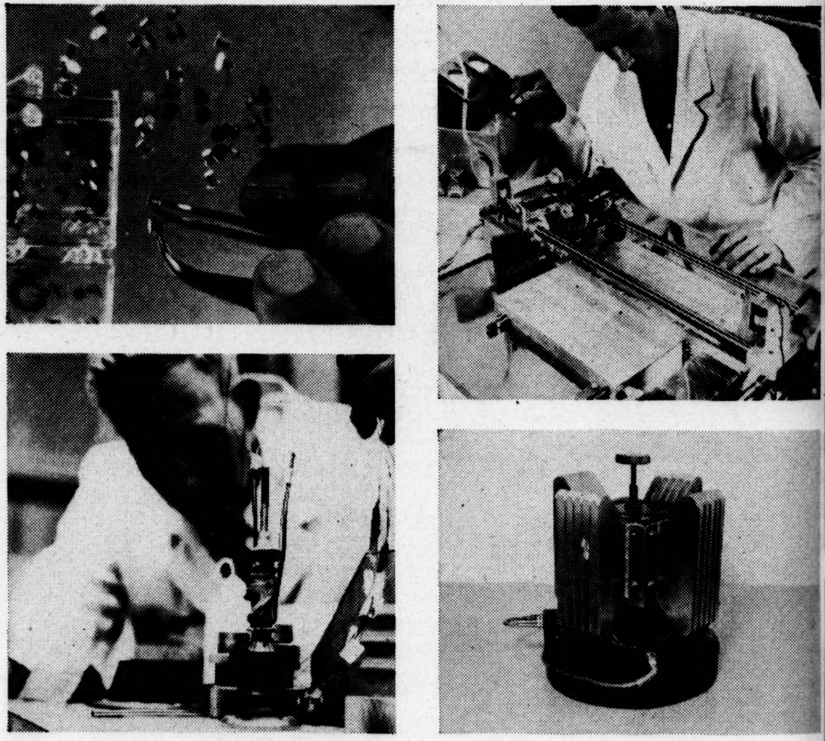
In addition to opportunities in direct conversion programs, other openings exist at General Atomic for men interested in such areas as: solid state dc to ac converters, electromagnetic metal-forming machines, theoretical and experimental studies of very high plasma flows, dynamics of materials and structures under high impact loads, unconventional space propulsion systems, high explosive experimentation, and nuclear instrumentation.

Please address inquiries to Manager of Employment, General Atomic, P. O. Box 608, San Diego 12, California. General Atomic is an Equal Opportunity Employer.

Developments at General Atomic

Following are some of the recent developments in direct conversion programs at General Atomic's John Jay Hopkins Laboratory in San Diego:

- Tiny thermoelectric elements—hundreds of times smaller than other units with the same power output—made possible by the development of new high-strength, negligible-resistance bonds of semiconductors to conductors.
- New-concept solar thermoelectric panels for space vehicle auxiliary power, being developed for the U.S. Air Force. Power systems using these lightweight panels are expected to have marked weight and cost advantages over present solar cell systems.
- Thermionic converters, including early experimental units which have already produced over 90 watts of power directly from the heat of nuclear fission, at efficiencies of 10 per cent. Converters for electric power applications in the future being developed for the Rocky Mountain-Pacific Nuclear Research Group and San Diego Gas & Electric Co. Converters for auxiliary space power applications being developed for U.S. Air Force.
- Compact low-cost thermoelectric generators that convert gas heat to electricity. An experimental five-watt thermoelectric generator, designed for mass production, is being built for the American Gas Association, representing the U.S. gas distributing industry.
- Thermoelectric units for refrigeration and air-conditioning.
- Development of new high-temperature thermoelectric materials, including rare earth sulfides. Development of high-temperature thermoelectric modules for the U.S. Navy.



Top left, tiny thermoelectric elements developed by General Atomic; top right, solar thermoelectric panels for auxiliary space power; bottom left, cesium cell thermionic converter; bottom right, experimental unit to convert gas heat directly into electricity.

GD GENERAL DYNAMICS | GENERAL ATOMIC DIVISION

Garrett Mfg., Ltd., Rexdale, Ontario, a subsidiary of the Garrett Corp., will supply the Canadian government with 69 ground support vehicles for Royal Canadian Air Force CF-104s under a $1,700,000 order. Gas turbines produced by the Garrett Corp.'s AiResearch Mfg. Div. of Arizona will be mounted on trailer-type vehicles and will provide compressed air for engine starting and electrical power for ground checkout of various systems on the planes.

Telemetry and instrumentation equipment will be subjected to 1,200g accelerations during six-month long tests at the Atomic Energy Commission Tonopah, Nev., test range. The equipment will be installed in 155-mm. shells and fired from surplus artillery pieces beginning in mid-December. Tests will be conducted by the Livermore Laboratory of Sandia Corp. The equipment to be tested may emit nuclear radiation or may be intended for later tests of tactical nuclear weapons.

Mid-air collision study and simulation program to determine pilot ability to detect and evaluate a threat and his skill in choosing a suitable escape maneuver will be conducted by Sperry Gyroscope Co. at Federal Aviation Agency's National Aviation Facilities Experimental Center in Atlantic City. The program, funded by an $85,000 FAA contract, will employ a modified gunnery trainer and flight simulator.

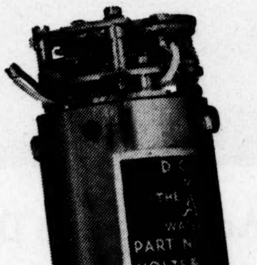
B. F. Goodrich Co.'s Aerospace and Defense Products Division will produce solid fuel motors for the Loki atmospheric sounding rocket at its Rialto, Calif., rocket engine plant under a $266,000 contract from the Navy. Delivery is scheduled for completion by the end of 1961.

Saab Aircraft Co. of Sweden has received an order from The Netherlands government's civil flying school for five additional Saab 91D Safir training aircraft, bringing the school's inventory of Safir models to 31.

Chance Vought Corp. has been awarded an $8,651,000 contract by the National Aeronautics and Space Administration for 14 additional four-stage Scout launch vehicles. This brings the number delivered or on order to 25.

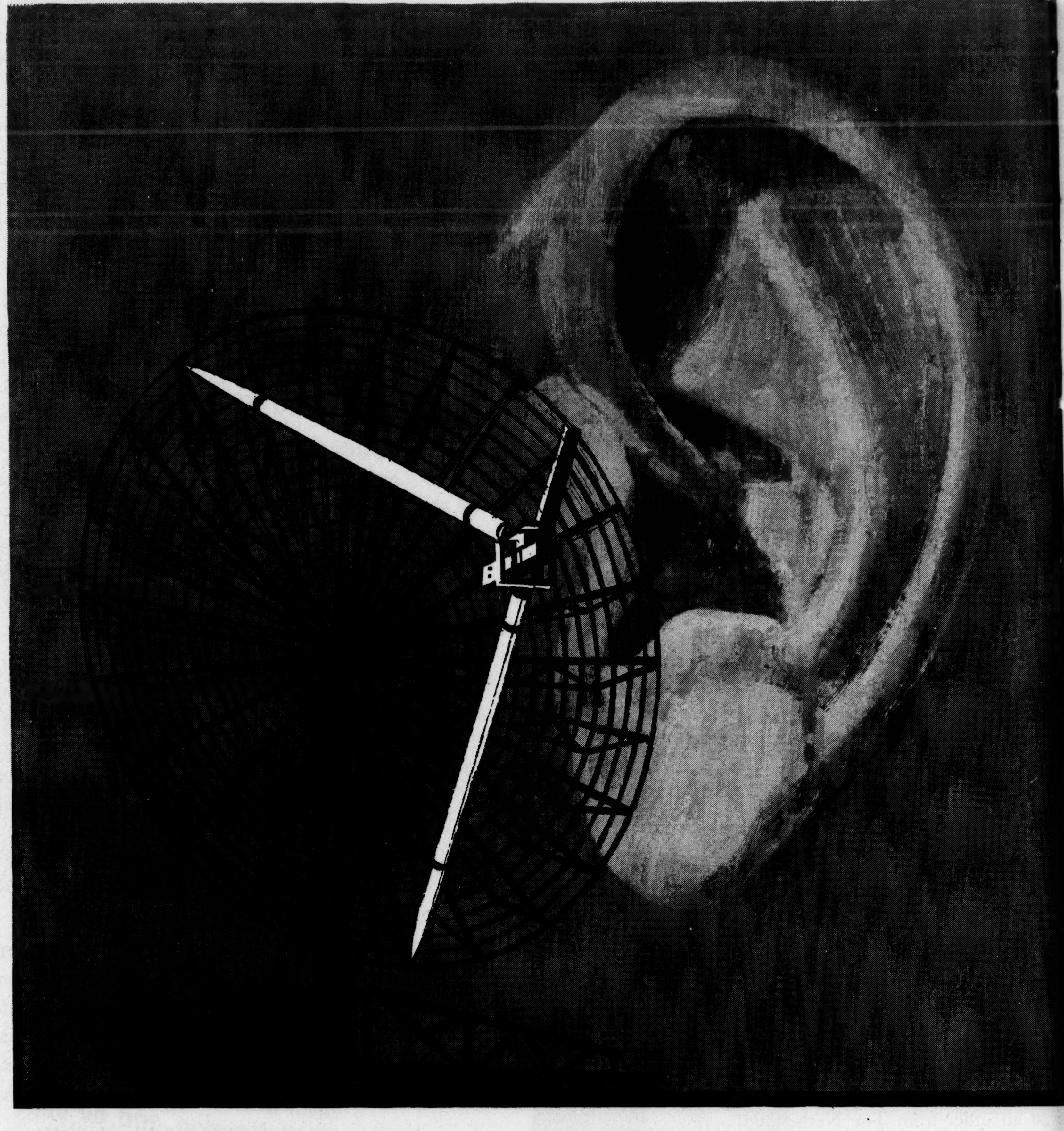
Goodyear Aircraft Co., Akron, Ohio, has received a follow-on contract of $1,417,479 from the Navy to furnish two F8U-2N weapons systems trainers. The units will be used to train pilots in using radar aboard all-weather fighter aircraft.

SOME TIMERS DO ALL THEY ARE DESIGNED FOR—AND MORE. Others just make claims. A. W. Haydon's record speaks for itself. Behind each: 101 "pros" pooling their timing technology...sophisticated test labs to assure peak performance ...built-in reliability reflecting years of experience. ■ A. W. Haydon makes them all: timing motors, time delay relays, elapsed time indicators and the like—electronic marvels from Culver City, electromechanical wonders from Waterbury. Shown: chronometrically governed subminiature DC motor. Literature on request. ■ When it comes to timing devices, for anything from data processing to satellite communications—miniature, subminiature or microminiature—specify A. W. Haydon, and be certain of peak reliability.



PERFORMANCE OUTWEIGHS CLAIMS

THE AW HAYDON COMPANY
222 NORTH ELM STREET, WATERBURY 20, CONNECTICUT



ALERT: Litton Communication Systems Advance the Defense Posture of the Free World

Management of electronic communication systems is a proven capability of Litton Industries, whose European facilities alone include 750,000 square feet under roof and a 3600-man team of engineering, manufacturing and field support specialists.

Professionals qualified to contribute to or direct research, engineering, production or field service in communications and allied fields are invited to investigate the broad spectrum of career opportunities at Litton. An equal opportunity employer.

LITTON SYSTEMS, INC.
BEVERLY HILLS, CALIFORNIA
A DIVISION OF LITTON INDUSTRIES

TECHNOLOGIES: ADVANCED COMMUNICATION AND DATA RECORDING • COMMAND AND CONTROL • GUIDANCE AND CONTROL • COMPUTERS • BIOELECTRONICS • SPACE SCIENCE • ELECTRONIC COUNTERMEASURES

FINANCIAL

British United Files Public Fiscal Report

London—British United Airways, Britain's largest independent operator, revealed its financial structure for the first time and said it earned a net profit of $1,205,960 as of Dec. 31, 1960.

Profit figure is an increase of $809,240 over the previous year, according to M. H. D. Wyatt, BUA chairman and managing director.

Wyatt pointed out there is no British legal requirement for an independent to publish an annual report, but added: "In these days, when companies tend to be judged largely on their annual figures, the airlines as a whole seem to dwell more upon their losses—either actual or expected."

British United, which has 10 BAC 111 twin-jet transports on order, has received an Air Transport Licensing Board decision on its requests for a number of routes in competition with the state-owned British European Airways. For further details on the route awards see p. 41.

The airline, which includes a helicopter subsidiary and Channel Air Bridge, has capital and revenue reserves of $10,724,000, which includes 510,000 shares of ordinary (common) stock at $2.80 per share. Aircraft fleet is listed as an asset worth $29,368,000.

Shareholders, primarily shipping interests, are British & Commonwealth Shipping Co. (Aviation), Ltd., and The Clan Line Steamers, Ltd., 31.72%; Furness, Withy & Co., Ltd., 19.47%; Blue Star Line, Ltd., 19.47%; Broadminster Nominees, Ltd. (Whitehall Securities), 9.73%; Guinness, Mahon Nominess, Ltd., 9.73%; Hunting Aviation Management, Ltd., 7.79%, and minorities, 2.09%. British United group, which employes 3,000 persons, was formed last year by the merger of the Airwork Group and Hunting-Clan Air Transport. It now includes 20 companies.

New Offerings

Manson Laboratories, Inc., Stamford, Conn., engaged in research, design and custom manufacture of standard and special equipment primarily in the fields of communications, power supply and pulse techniques for individual and general use in military and industrial applications. Offering is 200,000 common shares at $5 per share. Of the proceeds, $645,000 will be used for repayment of factoring loans; $75,000 for research and development programs; the balance for leasehold improvements.

Rocket Power, Inc., Mesa, Ariz., engaged in research, design, development and manufacture of solid propellant actuated devices for missiles and military aircraft, solid propellants, rocket motors, rocket catapults and other related products. Offering is 200,000 common shares. In June, 1961 the company took over the assets and business and assumed the obligations and liabilities of Rocket Power/Talco-Bohanan Division of The Gabriel Co., and assumed $1,500,000 of Gabriel's indebtedness to Society National Bank of Cleveland. Proceeds, to the extent they do not exceed $1,500,000 (and subject to certain limitations), will be used to pay off the $1,500,000 obligation. At the present time The Gabriel Co. is the owner of all of the outstanding stock of Rocket Power, Inc.

North Atlantic Industries, Inc., Plainview, N. Y., engaged in designing and manufacturing proprietary precision electronic instrumentation and electromechanical devices. Offering is 131,500 common shares; 120,000 shares for public sale by the company, and 11,500 outstanding shares by the present holder. Of the company's proceeds, $200,000 will be used for the repayment of short-term bank loans; $100,000 for development and promotion of new products; $50,000 to build an inventory of finished products.

Metallurgical International, Inc., Wallington, N. J., engaged in reprocessing and manufacturing certain rare refractory metals by chemical, mechanical and furnace reduction methods. Offering is 145,000 Class A common shares at $3 per share. The company expects to use the proceeds to pay federal income taxes for 1960; to repay all indebtedness to a bank under an accounts receivable financing program; to pay sundry indebtedness; to purchase and install additional production facilities and equipment.

Astro-Science Corp., Culver City, Calif., engaged in designing, developing and manufacturing ground systems and equipment for the support and servicing of electronic systems, aircraft and missiles. Offering is 232,500 common shares; 150,000 shares for public sale by the company, and 82,500 outstanding shares by the present holders. The company's proceeds will be used to discharge bank loans incurred in part to finance acquisition of the business now known as American Astro-Systems, Inc., and in part for additional working capital.

Just Out!
HANDBOOK OF ASTRONAUTICAL ENGINEERING
Editor-in-Chief: H. H. KOELLE
Editorial Board Chairman: WERNER VON BRAUN

Provides the essential information necessary for designing today and tomorrow's space vehicles, and for calculating their cost and performance. Summarizes developments, new ideas in space flight. **Prepared by 150 specialists. 1850 pp., 1052 illus., $27.50**

10 Days' **FREE** Examination

RECENT ADVANCES IN HEAT AND MASS TRANSFER
Just Out. A collection of important widely used papers in Heat & Mass Transfer from the past decade. **Edit. by J. Hartnett, E. Eckert, H. Mickley, & R. Pigford. 416 pp., $9.75**

FOUNDATIONS OF FUTURE ELECTRONICS
Just Out. Fills the gap between fundamental discovery & direct application. Introduces the engineer to current pure science. **By D. Langmuir & W. Hershberger. 512 pp., $10.75**

AUTOMATIC CONTROL ENGINEERING
Just Out. Explains the principles of feed back control systems in mechanical engineering terms. **By F.H. Raven, 384 pp., $11.50**

WRITING FOR ENGINEERING AND SCIENCE
Provides comprehensive coverage of modern technical writing for engineer, scientist, & writer. Summarizes a host of techniques. **By T. Hicks, 432 pp., $7.50**

HANDBOOK OF FLUID DYNAMICS
Expert guidance on fundamental principles & practical applications of fluid dynamics. **By V. L. Streeter, 1240 pp., 907 illus., $24.00**

ENGINEERING MANAGEMENT AND ADMINISTRATION
Just Out. Shows the engineer how to manage an engineering department easily, efficiently, & profitably. **By V. Cronstedt, 441 pp., $8.50**

Free Examination Coupon

McGraw-Hill Book Co., Dept. AW-12-4
327 W. 41st St., New York 36, N. Y.

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep plus few cents for delivery costs, and return unwanted book(s) postpaid. (We pay delivery costs if you remit with this coupon—same return privilege.)

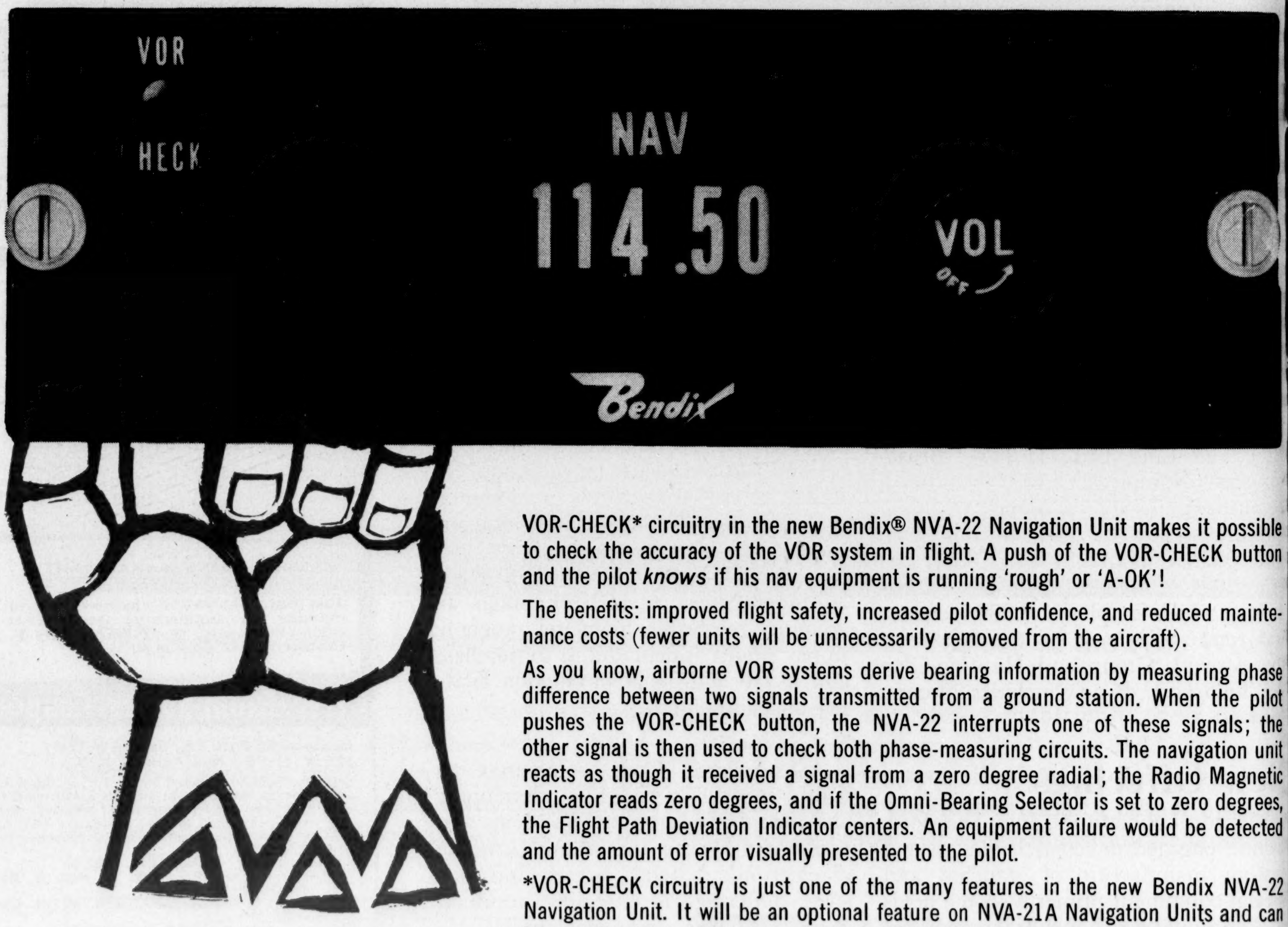
☐ Koelle—**Hdbk. of Astr. Eng.**—$27.50
☐ Hartnett et al.—**Rec. Adv. in Heat & Mass Trans.**—$9.75
☐ Langmuir & Hershberger—**Found. of Fut. Elec.**—$10.75
☐ Raven—**Auto. Control Eng.**—$11.50
☐ Hicks—**Writ. for Eng. & Science**—$7.50
☐ Streeter—**Hdbk. of Fluid Dyn.**—$24.00
☐ Cronstedt—**Eng. Mgmt. & Admin.**—$8.50

Name ....
Address ....
City.................. Zone.... State...........
Company ....
Position ....

For price and terms outside U.S. write McGraw-Hill Intl., N.Y.C. 36 **AW-12-4**

CHECK YOUR VOR SIGNALS WITH BENDIX VOR-CHECK!

33
0
3
6
9
12
15
18
21
24
27
30



VOR-CHECK* circuitry in the new Bendix® NVA-22 Navigation Unit makes it possible to check the accuracy of the VOR system in flight. A push of the VOR-CHECK button and the pilot *knows* if his nav equipment is running 'rough' or 'A-OK'!

The benefits: improved flight safety, increased pilot confidence, and reduced maintenance costs (fewer units will be unnecessarily removed from the aircraft).

As you know, airborne VOR systems derive bearing information by measuring phase difference between two signals transmitted from a ground station. When the pilot pushes the VOR-CHECK button, the NVA-22 interrupts one of these signals; the other signal is then used to check both phase-measuring circuits. The navigation unit reacts as though it received a signal from a zero degree radial; the Radio Magnetic Indicator reads zero degrees, and if the Omni-Bearing Selector is set to zero degrees, the Flight Path Deviation Indicator centers. An equipment failure would be detected and the amount of error visually presented to the pilot.

*VOR-CHECK circuitry is just one of the many features in the new Bendix NVA-22 Navigation Unit. It will be an optional feature on NVA-21A Navigation Units and can be retrofitted into NVA-21 series Navigation Units. Write Avionic Products, Baltimore 4, Maryland.

Bendix Radio Division

THE Bendix CORPORATION

Particle Accelerator Aids Space Research

Dallas, Tex.—Three-million-volt Van e Graaff particle accelerator is the eart of a $250,000-plus test facility hich Ling-Temco-Vought will use to onduct research ranging from basic uclear interactions to space radiation ffects on vehicles and systems.

The equipment, reputed to offer nany times the capabilities of most ccelerators now in use by U. S. indusry and research establishments, aleady is proving its worth. Company fficials indicate that the facility has a ull workload of programs which will e enlarged with the addition of more cientists at the facility.

Major areas of research falling ithin the study capability include eutron and positive ion cross sections, uclear radiation effects, space radiaion simulation, radiation shielding, econdary radiation (Bremsstrahlung), otope production, electronic compoent radiation effects, nuclear radiation etection and space radiation detection.

Of particular import to L-T-V cientists and engineers is the ability ow to conduct in-house studies of roblem areas concurrently with the ctual design of space vehicles and sysems. As one company researcher ointed out, time on nuclear particle ccelerators is harder to get now than as the case with wind tunnel time hen that aerodynamic research tool eached its height of demand.

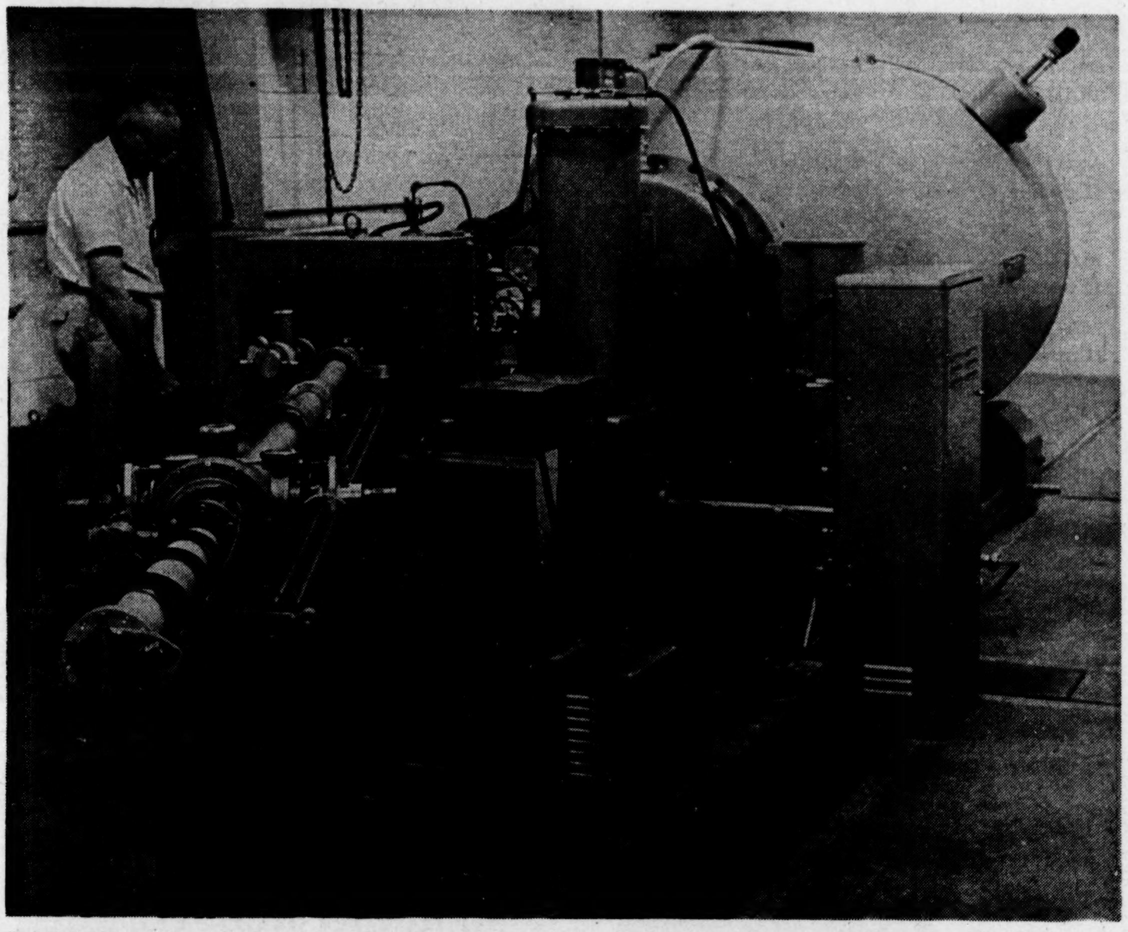
And, as L-T-V President Gifford K. ohnson pointed out, aerospace firms o longer can depend upon other ources for the required research, since ach new design today is unique and n many cases the technical requirenents dictate the research.

Projects under study here are as iverse as researching the effects of econdary radiation on materials and omponents of SLAM (supersonic lowltitude missile), the USAF-sponsored uclear-ramjet-powered program, to robing the possibilities of isotope adiation in activating photo-cells to roduce electrical energy—a field of inerest indicated by USAF.

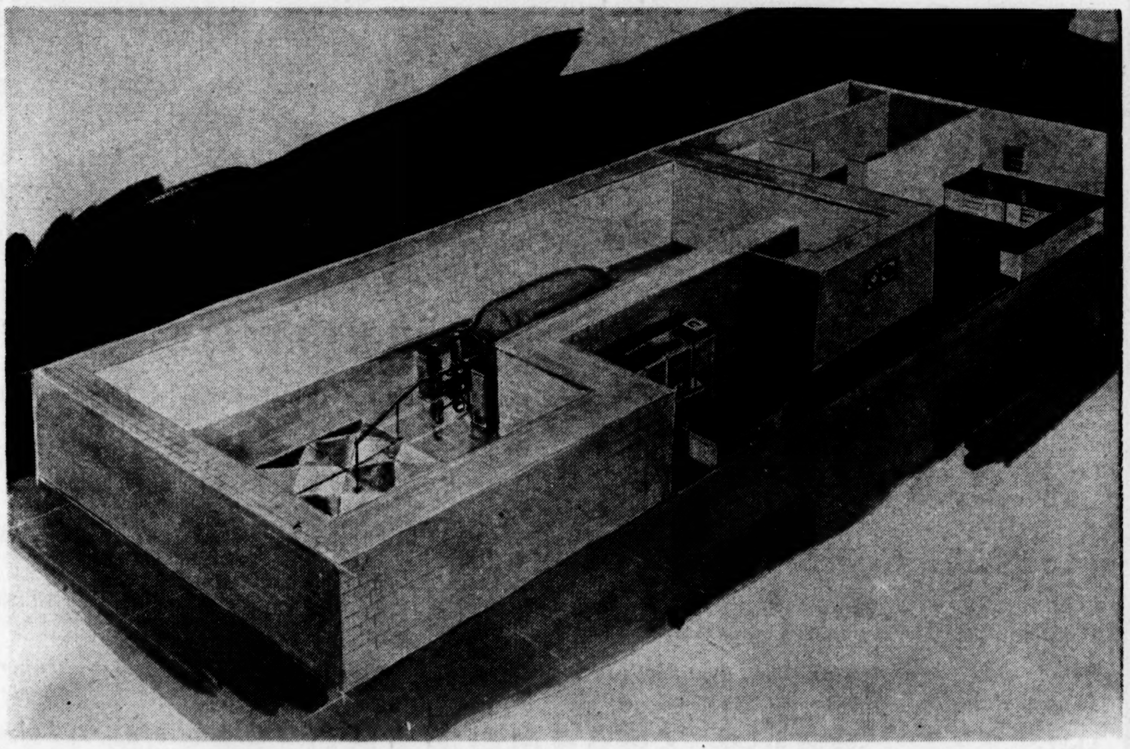
L-T-V's new equipment, built by High Voltage Engineering, Boston, Mass., will accelerate primary particles such as protons, deutrons, helium 3, alpha particles and electrons and will also produce secondary radiations such s gamma rays and neutrons.

It can produce 10^{12} neutrons per second using a B^9 (d, n) B^{10} reaction. Thermal yield exceeds 10^9 neutrons/sq. cm./sec. Under negative operation, the equipment will produce up to one milliampere of electrons at 3 mev. Gamma production exceeds 10^9 roentgens/hr. one foot from a gold target or in excess of that of a 50 kilocurie cobalt 60 source.

The equipment's capability to produce either positively charged protons or negatively charged electrons makes it readily possible to duplicate the intensities of the Van Allen Belts, Ling-Temco-Vought technicians point out.



TARGET END of the Van de Graaff particle accelerator (foreground) extends from the particle generating system which is encased in a pressurized chamber approximately 12 ft. long and 5 ft. in diameter. Magnet system, between tank and target, selects type and energy of particle desired for a particular reaction.



NUCLEAR RESEARCH LABORATORY and test facility operated by Ling-Temco-Vought is built around three-million volt Van de Graaff particle accelerator. The facility now has a full workload and plans to increase the number of scientists have been drafted.

Project Mercury Test Flights

MERCURY-ATLAS

VEHICLE	TEST OBJECTIVES	LAUNCH-DATE	RESULTS
Big Joe (R&D capsule)	Ballistic test of ablative heat shield, afterbody heating, entry dynamics, attitude control, sequencing, recovery operations.	Sept. 9, 59	Objectives achieved, programed capsule-booster separation did not occur.
MA-1 (Capsule 4)	Structural integrity in ballistic flight, performance of afterbody shingles, heat rates, dynamics, abort sequence, recovery.	July 20, 60	Failure—launch vehicle exploded 65 sec. after ignition.
MA-2 (Capsule 6)	Abort re-entry, heat shield performance, dynamics, structure, booster performance, recovery.	Feb. 21, 61	All objectives achieved.
MA-3 (Capsule 8)	Single-orbit to test complete capsule-booster system; exercise tracking range, recovery	Apr. 25, 61	Failure—launch vehicle did not roll to 70-deg. heading and was destroyed. Capsule recovered intact.
MA-4 (Capsule 8)	Repeat MA-3.	Sept. 13, 61	All objectives achieved.
MA-5 (Capsule 9)	Three-orbit mission—chimpanzee passenger.	Nov. 61	
MA-6 (Capsule 12)	Three-orbit astronaut flight.		
MA-7 (Capsule 18)	Same as MA-6.		
MA-8 (Capsule 19)	Same as MA-6.		
MA-9 (Capsule 20)	Same as MA-6.		

NOTE: All launches from Atlantic Missile Range on 108-deg. azimuth. Tentative plans for MA-10 through MA-14 using advanced capsules.

MERCURY-REDSTONE

VEHICLE	TEST OBJECTIVES	LAUNCH-DATE	RESULTS
MR-1 (Capsule 2)	Qualify capsule in ballistic flight.	Dec. 19, 60	All objectives achieved; mission preceded by brief booster liftoff. Capsule refitted, booster replaced.
MR-2 (Capsule 5)	Qualify environmental system with passenger-chimpanzee Ham.	Jan. 31, 61	All objectives achieved—overshot target by 130 mi. when throttle jammed open under launch vibration.
MRBD (R&D capsule)	Booster development test.	Mar. 24, 61	All objectives achieved.
MR-3 (Capsule 7)	Pilot training, capsule qualification. First U.S. astronaut flight—Cdr. Alan Shepard.	May 5, 61	All objectives achieved.
MR-4 (Capsule 11)	Same as MR-3—Capt. Virgil Grissom.	July 21, 61	All objectives achieved—capsule shipped seawater and sank.

NOTE: All launches from AMR on 105-deg. azimuth. MR5-MR7 eliminated.

MERCURY-LITTLE JOE

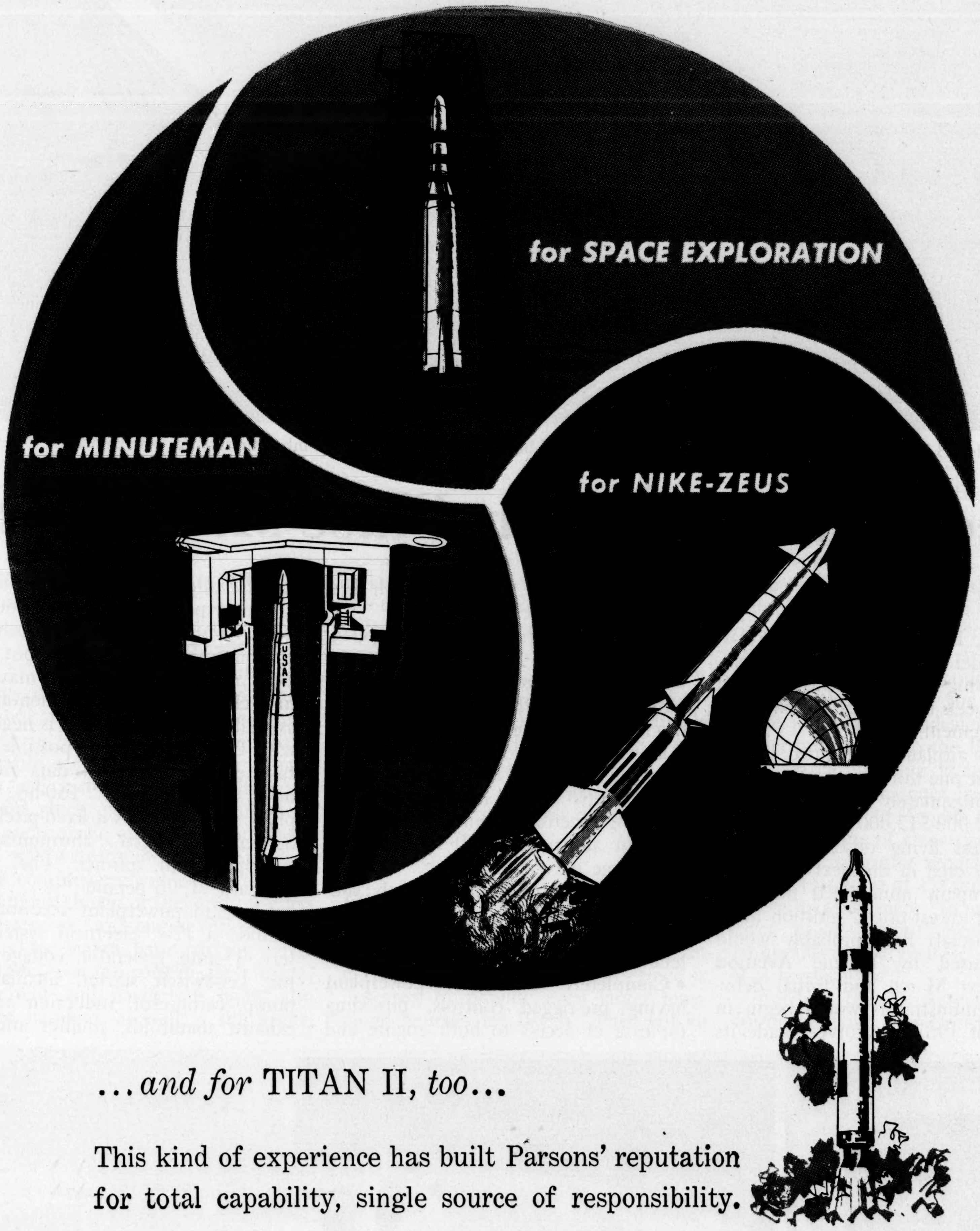
VEHICLE	TEST OBJECTIVES	LAUNCH-DATE	RESULTS
LJ-I (R&D capsule)	Qualify booster cluster and booster-capsule configuration.	Oct. 4, 59	All objectives achieved.
LJ-II (R&D capsule)	Qualify escape, recovery systems.	Nov. 4, 59	Capsule tumbled—partial success.
LJ-III (R&D capsule)	High altitude abort—with Rhesus monkey Sam	Dec. 4, 59	All objectives achieved.
LJ-IV (R&D capsule)	Maximum dynamic pressure abort—with Rhesus monkey Miss Sam.	Jan. 21, 60	All objectives achieved.
LJ-V (Capsule 3)	Maximum dynamic pressure abort with production capsule.	Nov. 8, 60	Failure—no booster-capsule separation because of circuit malfunction.
LJ-VI (Capsule 14)	Same as LJ-V	Mar. 18, 61	Failure—sequencer malfunction caused escape rocket to fire prematurely. Capsule recovered.
LJ-VII	Same as LJ-V	Apr. 28, 61	All objectives achieved.

NOTE: All launches from Wallops Island, Va., on 135-deg. azimuth.

MERCURY-SCOUT

VEHICLE	TEST OBJECTIVES	LAUNCH-DATE	RESULTS
MS-1 (USAF Blue Scout)	Exercise tracking net in 3-orbit mission.	Nov. 1, 61	Failure—vehicle did not follow program and was destroyed 30 sec. after liftoff.

Look to Parsons for Performance
IN MISSILE AND ROCKET FACILITIES



...and for TITAN II, *too...*

This kind of experience has built Parsons' reputation for total capability, single source of responsibility.

THE RALPH M. PARSONS COMPANY

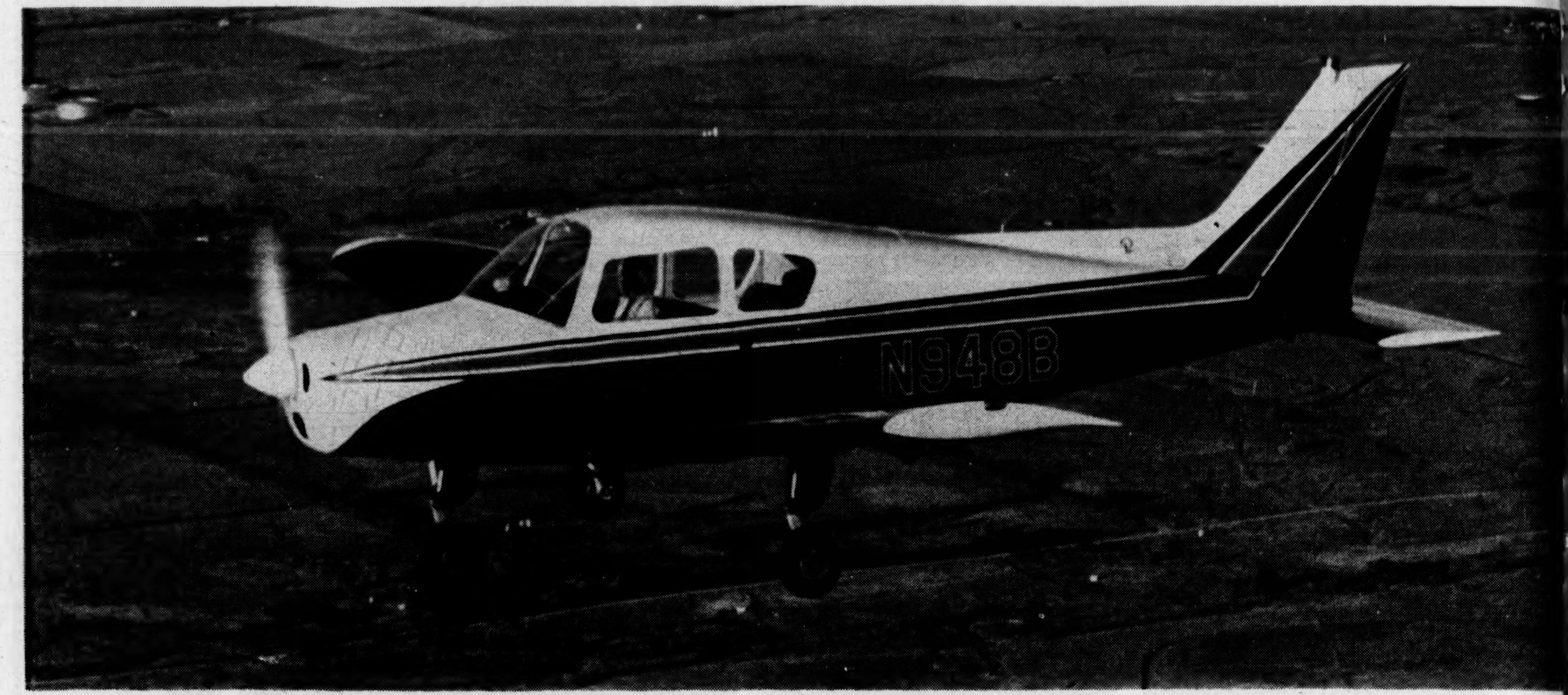
ENGINEERS • CONSTRUCTORS
LOS ANGELES / NEW YORK

LONDON
PARIS
WASHINGTON

OFFICES IN
OTHER
PRINCIPAL CITIES
THROUGHOUT
THE WORLD

PARSONS

WORLD WIDE SERVICES: APPRAISALS AND ECONOMIC STUDIES • ARCHITECT-ENGINEERING • CONSTRUCTION • ELECTRONIC SYSTEMS AND COMPONENTS • MINING AND METALLURGICAL ENGINEERING • PERSONNEL TRAINING • PETROLEUM-CHEMICAL ENGINEERING PETROLEUM PRODUCTION SYSTEMS • PLANT OPERATION • POWER PLANT ENGINEERING • WATER DEVELOPMENT AND SYSTEMS



BEECH Model 23 Musketeer lightplane's wings are constructed of bonded aluminum honeycomb. Aircraft has four seats.

Beech Schedules Four-Place Musketeer f

By Erwin J. Bulban

Wichita, Kan.—New Beech Aircraft Corp. Model 23 Musketeer single-engine, low-wing lightplane was unveiled here last week before key Beech retail and management officials.

The new airplane is designed to capture at least one-third of the total market of approximately 13,500 airplanes in the $10,000-$12,000 price category that business flying observers predict will be delivered in the next five years.

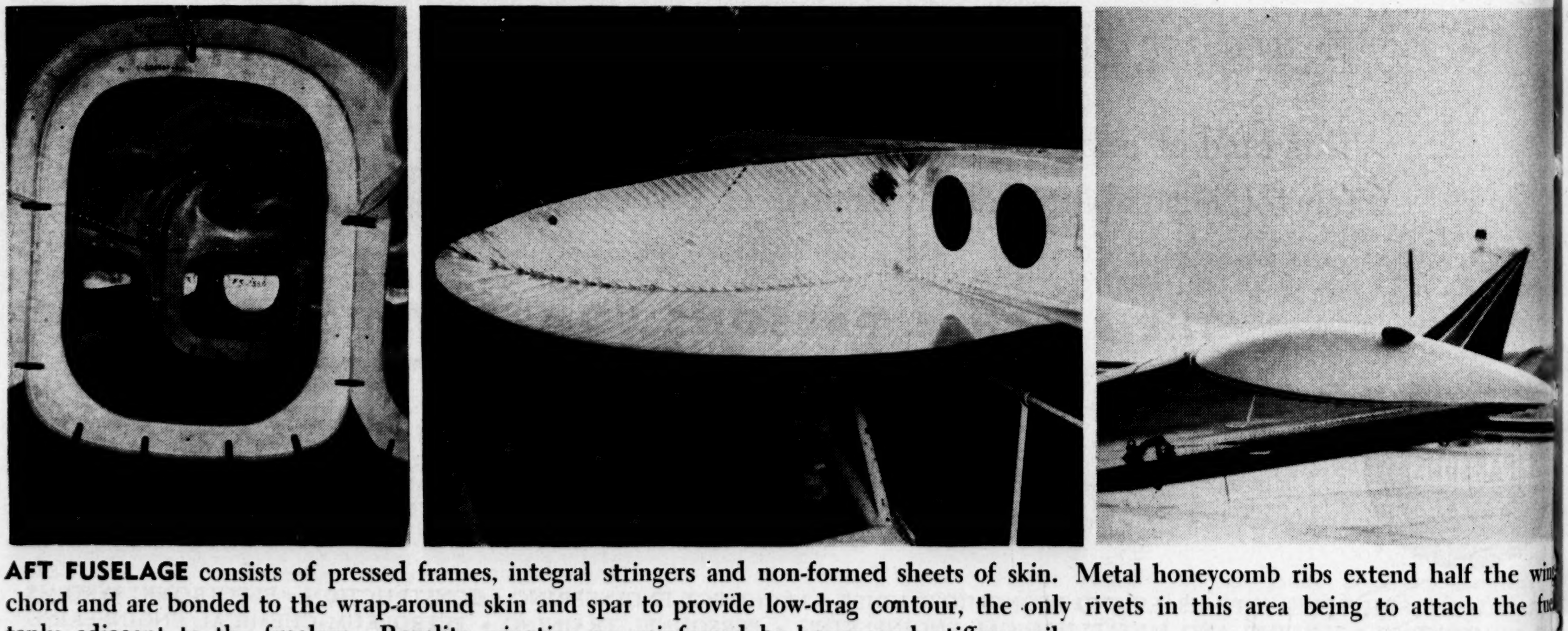
The company announced that this newest and lowest-priced addition to its business aircraft fleet probably would be certificated by Federal Aviation Agency next March and initial deliveries of demonstrators would begin in early fall of 1963. Prototype made its first flight Oct. 23, flown by Beech Test Pilot Steve Tuttle.

Significant features of the Musketeer include:

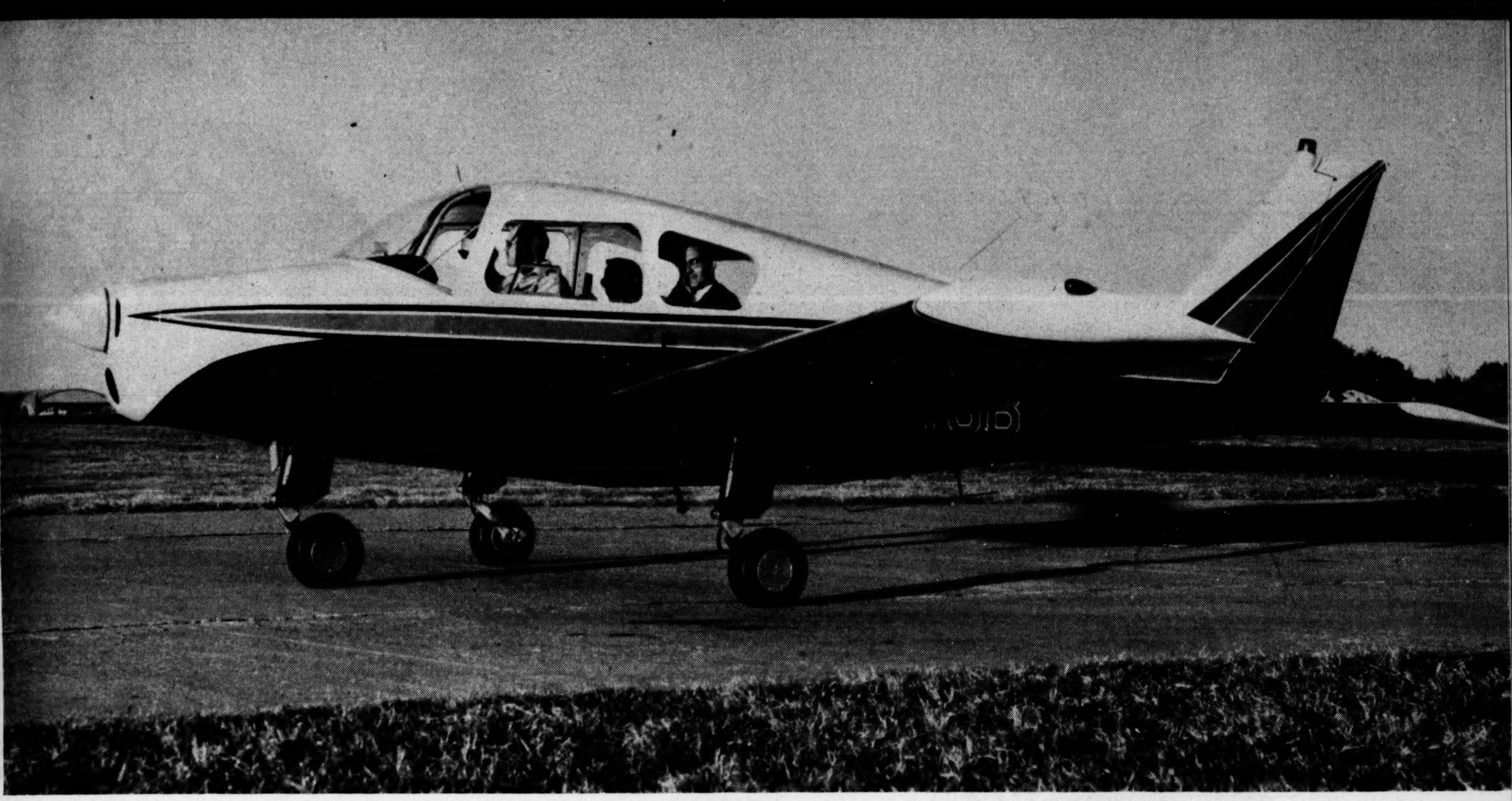
- **Price of "approximately $12,000"**—indications are that the company is shooting to set the figure at just under this—which would include as standard equipment essential instrumentation for cross-country flight and a Beechcraft VHF transceiver communications set plus an additional VHF receiver for omnirange navigation.
- **Bonded aluminum honeycomb** construction is utilized in the wings—believed to be the first application of this technique to a light business airplane.
- **Completely detachable powerplant** having pre-rigged controls, providing for ease of access to both engine and the forward portion of the airframe

Prototype Musketeer has a four-cylin- der Lycoming O-320-B2C engine rated at 160 hp. at 2,700 rpm., but indica- tions are that although this may be th final choice for the production airplane as well, management still is negotiatin with Continental on a possible substi tute engine. Released data mention only an un-named "160-hp. power plant." Propeller is a fixed-pitch 74-i Sensenich forged aluminum typ equipped with spinner. Fuel type standard 91/96 octane.

Standard powerplant accessories wi include a 12-v. electrical system, ba tery, 35-amp. generator, voltage regula tor, key-switch starter, auxiliary fu pump, carburetor, induction air filte exhaust manifolds, muffler and cabi



AFT FUSELAGE consists of pressed frames, integral stringers and non-formed sheets of skin. Metal honeycomb ribs extend half the wi chord and are bonded to the wrap-around skin and spar to provide low-drag contour, the only rivets in this area being to attach the fu tanks adjacent to the fuselage. Royalite wingtips are reinforced by honeycomb stiffener rib.



MUSKETEER prototype is powered by a four-cylinder Lycoming O-320-B2C engine rated at 160 hp. at 2,700 rpm.

963 Market

heater. Main landing gear is fitted with hydraulic brakes.

Basic airplane is planned as a "ready-to-fly" piece of equipment, with items listed as standard including ventilating, heating and defrosting systems, track-mounted front seats—with left seat locking in any of five positions—and adjustable seat backs. Standard flight group will include airspeed, altimeter, compass, clock, rate-of-climb, turn-and-bank and outside air temperature gages and a stall warning indicator. Standard engine complement will include tachometer, engine cluster of fuel and oil gages and ammeter, and engine primer. Individual toe brakes, hand parking brake, adjustable trim tab control, land, cabin, instrument and navigation lights also will be standard, as well as sun visors, ash trays and glove compartment. Optionals will include dual control system, vacuum system, gyro horizon and directional gyro, autopilot, ADF radio, winterization kit, heated pitot tube and internal corrosion proofing.

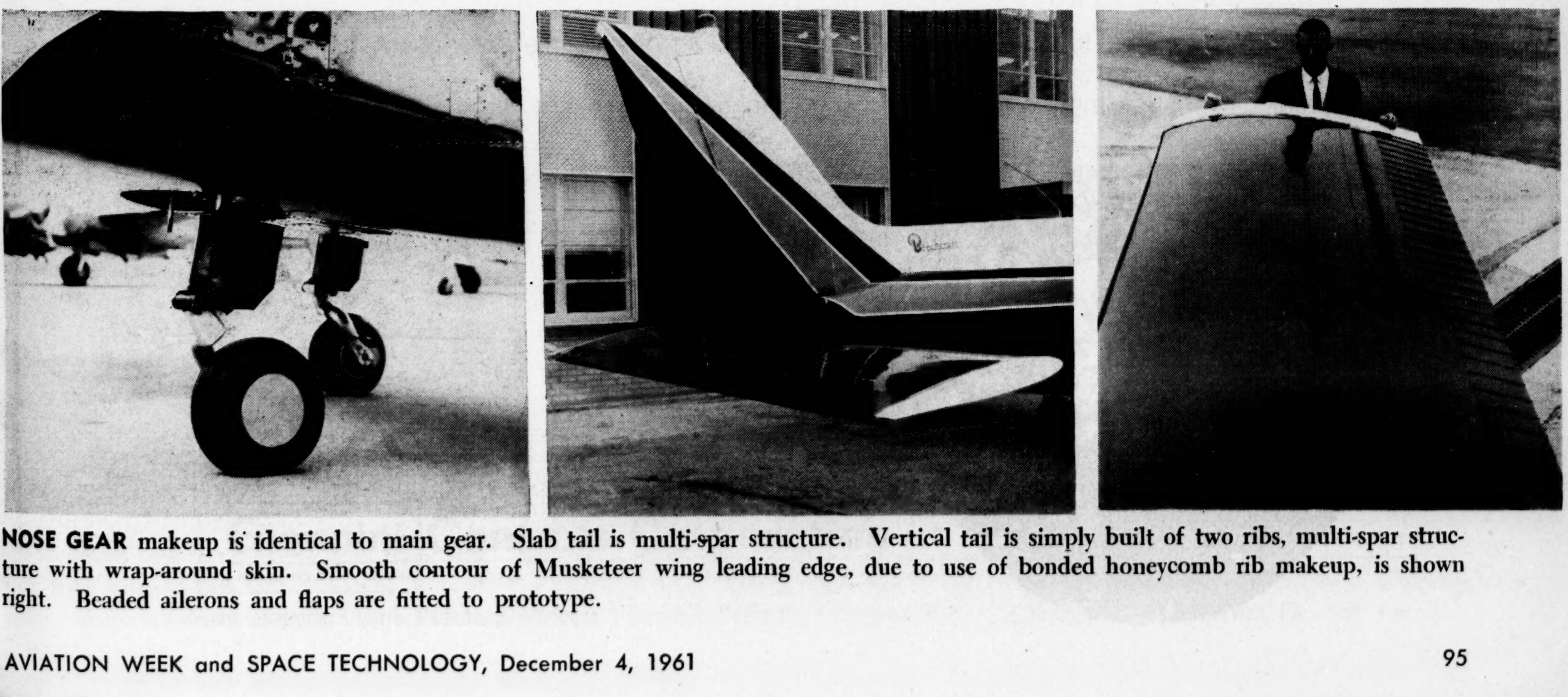
Beech management is specifically aiming the Musketeer to be competitive with the Piper PA-28 Cherokee—which uses the same powerplant as the prototype Model 23—and the Cessna Models 172 Skyhawk and 175 Skylark, and laid down basic performance and cabin area parameters of these airplanes as guides for its engineering department to consider in sizing the new Model 23 Musketeer.

Price Advantages

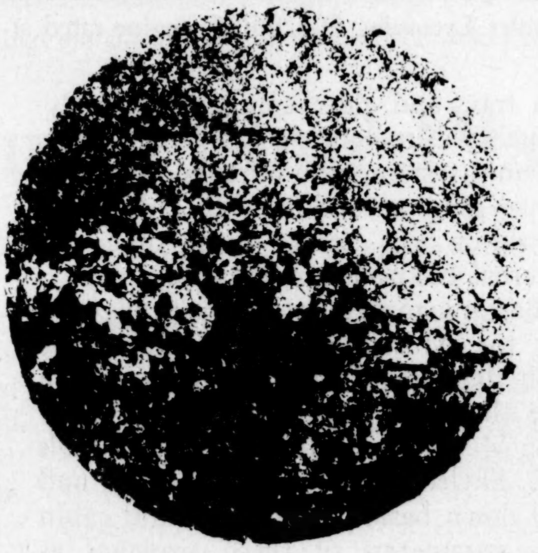
But beyond attempting to garner the one-third slice of the good-sized market it foresees for this airplane, its price is expected to provide even larger long-range benefits for Beech. This will be made possible because the price range of the Musketeer will enable the company's marketing organization to lure considerably more dealers into its fold since the cost of getting started with a demonstrator of this type will be easier financially than it was with the firm's higher-priced line.

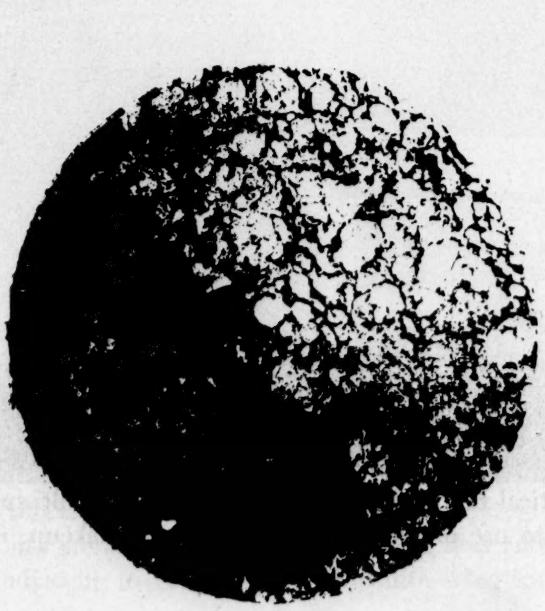
Also important in modern merchandising is the fact that the airplane will make it possible for dealers to get customer prospects into the Beech "family line" earlier in their flying careers. It has been a basic tenet in the business that it is easier to upgrade the customer-pilot from one of a company's airplanes to a more expensive model later than it is to get him out of a competitor's product into your own. In addition, this later process often means taking a competitive-make airplane in trade when it is accomplished.

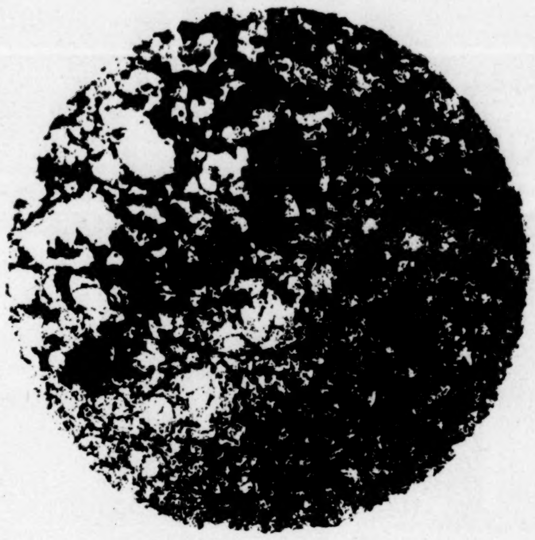
Further, the Musketeer is designed for docile flying characteristics and, with

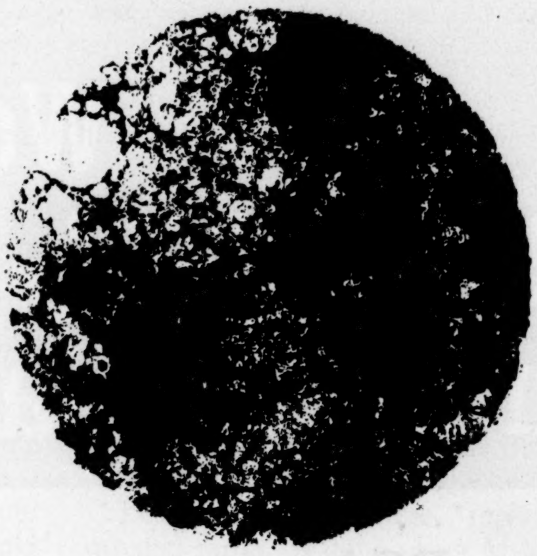


NOSE GEAR makeup is identical to main gear. Slab tail is multi-spar structure. Vertical tail is simply built of two ribs, multi-spar structure with wrap-around skin. Smooth contour of Musketeer wing leading edge, due to use of bonded honeycomb rib makeup, is shown right. Beaded ailerons and flaps are fitted to prototype.









TOTAL PERFORMANCE

Total performance of your Giannini Controls airborne instrument or system has many phases. Designed-in function-effectiveness and long mean-time-between-failures. Production under a matured quality control system. Delivery on schedule in spite of last-minute changes. Flight readiness when received. Follow-up to integrate the product smoothly into your system. Ask the people on Titan, Atlas, F8U, Talos, Nike Zeus, Skybolt, Polaris, Discoverer, Mercury. You'll hear: **When it's from Giannini Controls you get it on time, it works when you get it, and it keeps on working.**

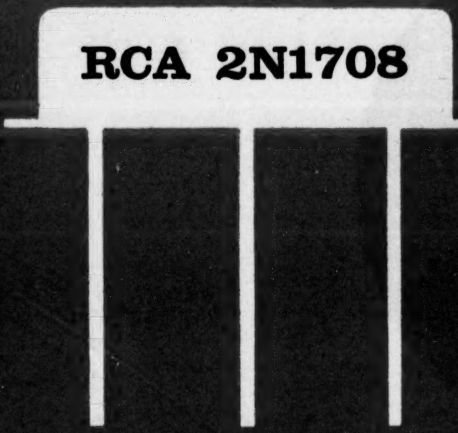
Giannini Controls Corporation 1600 South Mountain Avenue, Duarte, California

A NAME TO PLAN WITH

SERVO COMPONENTS & SYSTEMS • AIR DATA INSTRUMENTS & SYSTEMS • INERTIAL INSTRUMENTS & SYSTEMS

Plant locations: Duarte, Pasadena, Glendora & Glendale, California • Caldwell, N. J. • Centerbrook, Conn. • Berwyn, Pa. GCC 1-36

Now only from RCA



World's First Silicon PLANAR EPITAXIAL Switching Transistor in the miniature TO-46 Package

2N1708 Shown Actual Size
requires only
40% of TO-18 Headroom

RCA announces the 2N1708, first and fastest silicon planar-epitaxial computer transistor in the TO-46 packag

PLANAR CONSTRUCTION for excellent stability, high reliability. Collector cut-off current reduced by a factor of 20 to 1 over mesa types. Uniform beta over a wide current range. Maximum storage temperature—300°C.

EPITAXIAL CONSTRUCTION for low saturation voltage and improved switching times.

MINIATURE CASE for extremely high density packaging. Uses same lead arrangement as TO-18 package but requires only 40% of the TO-18 headroom.

BROAD SILICON LINE The new 2N1708 planar-epitaxial transistor is another example of RCA's advanced silicon technology, application-oriented to today's performance and miniature packaging requirements. The 2N1708 complements the other RCA silicon planar switching transistor types: USA 2N706, 2N706, 2N706-A, 2N708, 2N696, and 2N697.

Check the data on these outstanding RCA types. For information on RCA computer transistors and multiple switching diodes, call your RCA Field Representative. All these types are immediately available in quantity. For further technical information, write to RCA Semiconductor and Materials Division, Commercial Engineering, Section K-112-NN-3, Somerville, N. J.

	RCA 2N1708	
CHARACTERISTICS	TEST CONDITIONS	LIMITS
I_{CBO}	V_{CB} = 15 volts; $I_E = 0$	.025 μa
I_{CEX}	V_{CE} = 10 volts; V_{BE} = 0.35 volts; Free-air Temp. = 100°C	15 μa
V_{CE} (sat.)	I_C = 10 ma; I_B = 1 ma	.22 volts
V_{BE} (sat.)	I_C = 10 ma; i_b = 1 ma	.9 volts
t_s	I_C = 10 ma; I_{B_1} = 10 ma I_{B_2} = 10 ma;	25 seconds
$t_{\text{"on"}}$	I_C = 10 ma; I_{B_1} = 3 ma; I_{B_2} = 1 ma; V_{CC} = 3 volts	40 seconds
$t_{\text{"off"}}$	I_C = 10 ma; I_{B_1} = 3 ma; I_{B_2} = 1 ma; V_{CC} = 3 volts	75 seconds

RCA SEMICONDUCTOR & MATERIALS DIVISION—Field Offices... **EAST:** Newark, N. J., 744 Broad St., HUmboldt 5-3900 • (Camden, N. J. area) Erlton, N. J., 605 Marlton Pike, HAzel 8-4802 • Syracuse, N. Y., 731 James St., Room 402, GRanite 4-5591 • Baltimore, Md., ENterprise 9-1850 • **NORTHEAST:** Needham Heights 94, Mass., 64 "A" St., HIllcrest 4-7200 • **SOUTHEAST:** Orlando, Fla., 1520 Edgewater Drive, Suite #1, GArden 4-4768 • **EAST CENTRAL:** Detroit 2, Mich., 714 New Center Bldg., TRinity 5-5600 • **CENTRAL:** Chicago, Ill., Suite 1154, Merchandise Mart Plaza, WHitehall 4-2900 • Minneapolis, Minn., 5805 Excelsior Blvd., WEst 9-0676 • **WEST:** Los Angeles 22, Calif., 6801 E. Washington Blvd., RAymond 3-8361 • (San Francisco area) Burlingame, Calif., 1838 El Camino Real, OXford 7-1620 • **SOUTHWEST:** Dallas 7, Texas, 7905 Carpenter Freeway, FLeetwood 7-8167 • **GOV'T:** Dayton, Ohio, 224 N. Wilkinson St., BA 6-2366 • Washington, D.C., 1725 "K" St., N.W., FEderal 7-8500.

Available Through
Your RCA Distributor

RCA®
The Most Trusted Name in Electronics
RADIO CORPORATION OF AMERICA

its fixed gear, it becomes suitable for use by Beech dealers as a training airplane.

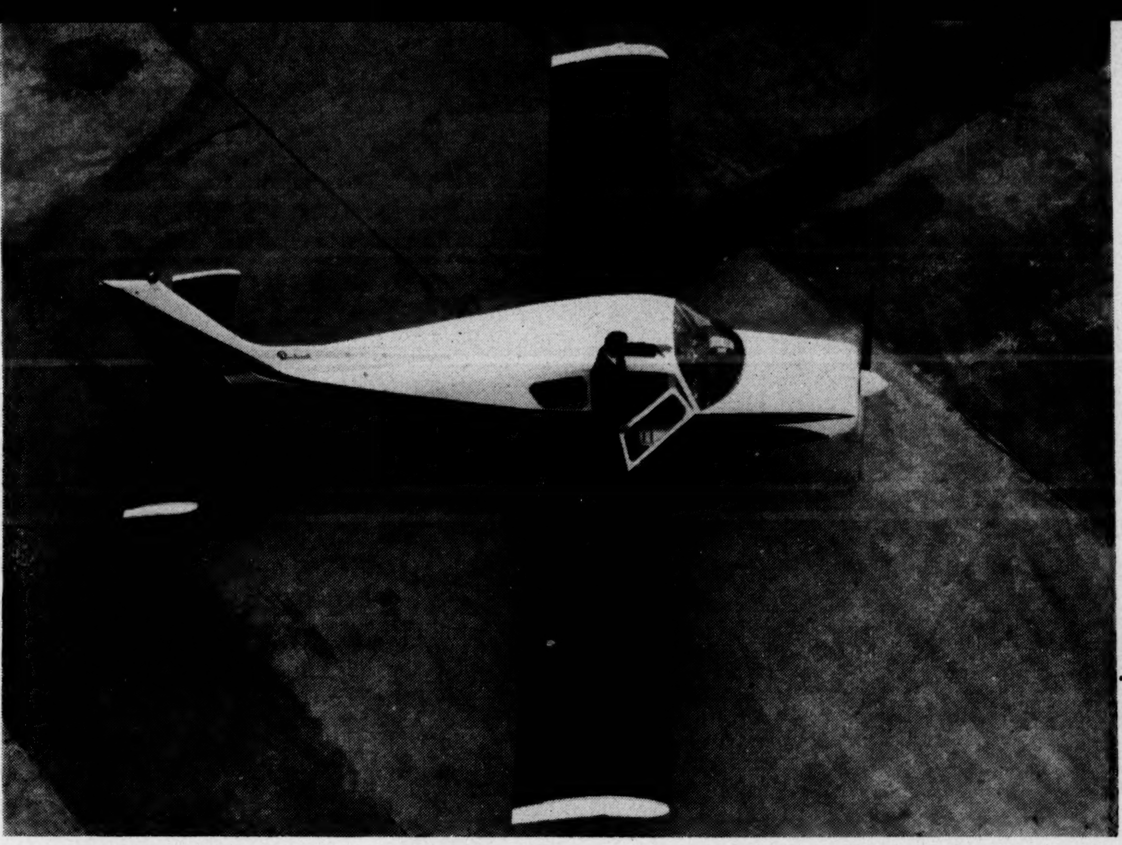
At the request of Beech dealers who plan to use the airplane for training purposes for students who plan to go on to aircraft with retractable landing gear, the company will provide a simulated retractable landing gear switch kit so that students can simulate retraction and extension procedures.

Model 23 Musketeer project began with initiation of marketing studies several years ago, but preliminary design was actually completed last January. On May 15, management gave the go-ahead to the engineering department to do detail design and construct the prototype. Since the project entailed designing an airplane at a price range well below previous types it was obvious from the start that an engineering "task force" group would have to be set up and isolated from all other day-to-day work to independently explore breakaways from conventional thinking and fabrication techniques in order to attain the management goal of maximum performance from an airframe requiring minimum machine set-ups and related production costs.

Task force for PD-169—as the Model 23 preliminary design was known—comprised 10 engineers with John Elliott as project chief reporting past normal engineering channels to management. This system, it turned out, played a significant role in the final configuration and in compressing normal design-to-hardware time.

For one, indications are that the preliminary design had considered use of a conventional multi-spar and rib structure, which under further examination looked as if it would not permit meeting the weight and fabrication cost goals that were being sought. Elliott, previous to being Debonair project engineer, had been in Beech Aircraft's military subcontract division, where his experience included fabrication of metal honeycomb bonded structures used in tail sections of the supersonic General Dynamics F-106.

Study of application of this technique indicated that it was the most plausible way of overcoming the roadblock that faced PD-169 and on June 6th the decision was made to go to this honeycomb concept for the new airplane. Despite this switch, the group completed the necessary engineering July 15, and rollout of the prototype was accomplished the end of September.



MUSKETEER wing, from spar to leading edge, has ribs bonded to the spar and the single piece wrap-around skins, providing a rivetless surface in this area to retain the best characteristics of the laminar-flow airfoil.

Wing basically is a two-piece structure, with a one-piece 14ST aluminum extruded taper-milled spar at 50% chord butted at the fuselage center line with splice plates and bolted. Spar attachment is of the "floating" type, whereby connection is via four lugs that take shear loads out through the fuselage frames.

In place of conventional rib structure, the wing utilizes one-inch-thick truss-grid ribs built up of eight layers of General Grid Corp. corrugated aluminum with layers bonded alternately at 45-deg. Ribs are used only forward of the main spar and are approximately 13 in. apart with a maximum spacing of 18 in. at the wingtips. There is a total of 10 such ribs in each wing; four in the leading edge integral fuel tanks adjacent to the cockpit and six outboard of the tanks. Ribs in the tank area have cutouts to permit fuel flow—others are solid.

The wing structure from spar to leading edge, comprising some 50% of wing chord, has ribs bonded to the spar and the single piece wrap-around skins, providing a rivetless surface in this area to retain the optimum characteristics of the laminar-flow airfoil.

There is one exception to this. The leading edge fuel tanks are designed to be replaceable. This is accomplished by having them faced at the rear by a false spar approximately two inches forward of the main spar and on either side by aluminum cast ribs. In event tanks require replacement, they are removed by simply drilling out the rivets.

Leak sealing for these "replaceable-integral tanks" is done using Minnesota Mining & Mfg. Co.'s Scotchweld; the same company's AF 110 bonding agent is used for fixing ribs to the spar and wing skins.

Fuel tanks are 30-gal. capacity, for a total of 60 gal. when completely full. However, by means of a gage on the filler neck of each tank, input can be measured so that each tank is loaded

Musketeer Weight Summary*

Gross weight (normal category)	2,300 lb.
Gross weight (utility category†)	1,950 lb.
Empty weight (minus standard equipment)	1,235 lb.
Empty weight (with standard equipment)	1,265 lb.
Useful load (with standard equipment and 40 gal. fuel)	1,035 lb.
Useful load breakdown:	
Pilot and three passengers	680 lb.
Baggage	91 lb.
Usable fuel	240 lb.
Unusable fuel	6 lb.
Usable oil	15 lb.
Unusable oil	3 lb.
Wing group	276 lb.
Tail group	56 lb.
Body group	207 lb.
Propulsion group	346 lb.
Instrument group	10 lb.
Electrical group	50 lb.
Furnishings and equipment	92 lb.

* Group weights based on preliminary data for prototype airplane.

† For instructional purposes, approved for spins.

Raytheon solution for spac

Recovery of space vehicles is a long range problem, commencing at atmosphere entry. Techniques for control from re-entry through touchdown, developed by Raytheon, are comparable to GCA concepts. Over the past two years, Raytheon has conducted a major and continuous investigation of the means by which a manned maneuverable space vehicle can be returned safely from flights in space to normal routine landing on earth. These investigations have included operational control concepts, instrumentation, information flo analysis, basic system requirements and subsyste specifications.

Part of this effort was a space vehicle recovery stud for the Air Force Flight Test Center encompassin vehicle energy management, glider characteristics trajectory analysis, flight parameter accuracies, rang instrumentation, navigation, communications, dat processing display, and human factors.

vehicle recovery: LONG RANGE GCA

Other portions of the effort included earth return navigation and recovery studies for SLOMAR (as a subcontractor to the Martin Company), and joint efforts with Bell Aerosystems Company on DYNA-SOAR Terminal Navigation Systems.

Currently, major emphasis is being placed on the APOLLO Ground Operational Support System (GOSS). This system will include global range instrumentation for tracking; telemetry and communications; and control, display and computation centers.

One of the world's largest scientific-industrial organizations, Raytheon has proven capability to create the required technology and manage every phase of a space vehicle recovery system — from early study and design through development, production and field support of operational systems and equipment.

Executive Offices, Lexington 73, Massachusetts.

RAYTHEON COMPANY

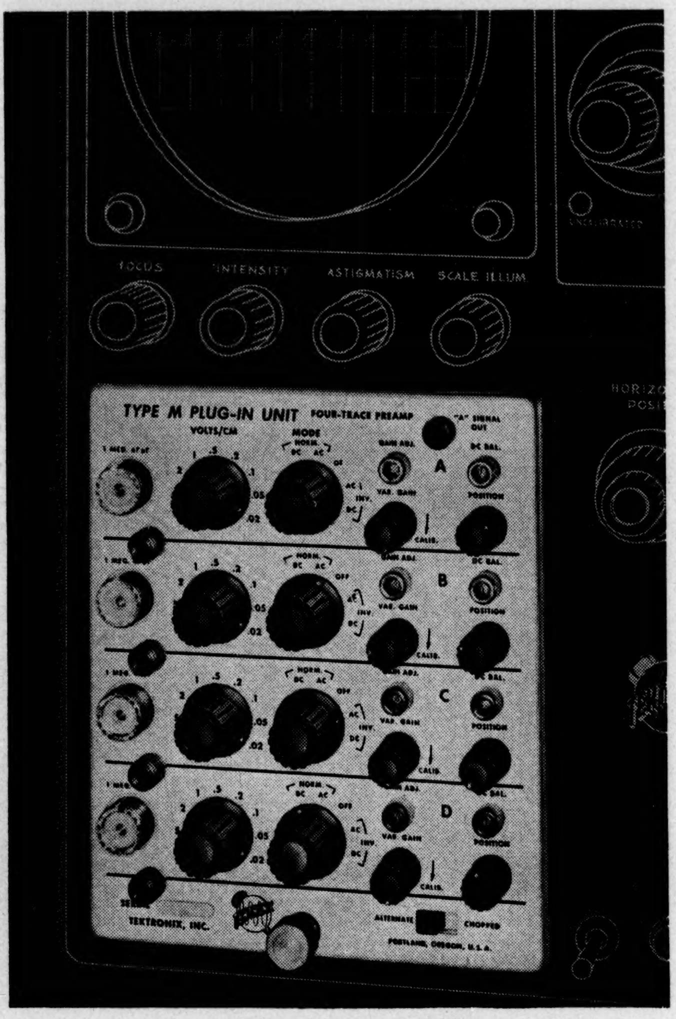
RAYTHEON

EQUIPMENT DIVISION

Communications, Radar, Sonar, Guidance, Data Processing and Display, Countermeasures, Systems Design and Management, Basic Research

NEW
4-TRACE
PREAMPLIFIER

for Tektronix Oscilloscopes that accept letter-series plug-in units



TYPE M UNIT Seventeenth in the letter-series of plug-in units, the new Type M Unit adds multiple-trace displays to the wide range of applications possible with your Tektronix oscilloscope.

With a Type M Unit, you can observe up to four signals—either separately, or in any combination.

Independent controls for each amplifier channel permit you to position, attenuate, invert input signals as desired.

Other convenient preamplifier features—such as triggered or free-running electronic switching . . . ac-coupling or dc-coupling . . . and, after initial hookup, little or no cable switching—ideally suit the new Type M Unit for multiple-trace presentations in the laboratory or in the field.

CHARACTERISTICS

Operating Modes—Any combination of one to four channels electronically switched—at the end of each sweep or at a free-running rate of about 1 mc (1 μsec width samples). Or each channel separately. *Channel Sensitivity*—20 mv/cm to 10 v/cm in 9 calibrated steps. Continuously variable uncalibrated between steps, and to 25 v/cm. *Channel A Signal*—available on front panel for optimum triggering in some applications. *Frequency Response and Risetime*—With Type 540-Series and Type 550-Series Oscilloscopes dc to 20 mc, 17 nsec. With Type 531A, 533A, 535A Oscilloscopes dc to 14 mc, 25 nsec. *Constant Input Impedance*—at all attenuator settings.

Type M Plug-in Unit . . U.S. Sales Price, f.o.b. Beaverton, Oregon . . . $455.00

For a demonstration of this new 4-Trace Preamplifier, please call your Tektronix Field Engineer.

Tektronix, Inc.

P. O. BOX 500 · BEAVERTON, OREGON / MItchell 4-0161 · TWX—BEAV 311 · Cable: TEKTRONIX

TEKTRONIX FIELD OFFICES: Albuquerque, N. Mex. • Atlanta, Ga. • Baltimore (Towson) Md. • Boston (Lexington) Mass. • Buffalo, N.Y. • Chicago (Park Ridge) Ill. • Cleveland, Ohio • Dallas, Texas • Dayton, Ohio • Denver, Colo. • Detroit (Lathrup Village) Mich. • Endicott (Endwell) N.Y. • Greensboro, N.C. • Houston, Texas • Indianapolis, Ind. • Kansas City (Mission) Kan. • Los Angeles, Calif. Area (East L.A. • Encino • West L.A.) • Minneapolis, Minn. • Montreal, Quebec, Canada New York City Area (Albertson, L.I., N.Y. • Stamford, Conn. • Union, N.J.) • Orlando, Fla. • Philadelphia, Pa. • Phoenix (Scottsdale) Ariz. • Portland, Oreg. • Poughkeepsie, N.Y. • San Diego, Calif. • San Francisco, Calif. Area (Lafayette, Palo Alto) • Seattle, Wash. • Syracuse, N.Y. • Toronto (Willowdale) Ont., Canada • Washington, D.C. (Annandale, Va.)

ENGINEERING REPRESENTATIVES: Kentron Hawaii Ltd., Honolulu, Hawaii. Tektronix is represented in twenty-five overseas countries by qualified engineering organizations.

European and African countries, the countries of Lebanon and Turkey, please contact TEKTRONIX INTERNATIONAL A.G., Terrassenweg 1A, Zug, Switzerland, for the name of your local engineering representative.

Other Overseas areas, please write or cable directly to Tektronix, Inc., International Marketing Department, P. O. Box 500, Beaverton, Oregon, U.S.A. Cable: TEKTRONIX.

to only 20-gal., in event higher pa loads must be carried.

Remainder of the wing is constitute of conventional sheet-metal sub spa to carry the ailerons and flaps, wit skin from main spar to sub spars bein flush riveted. Ailerons and flaps o prototype comprise single-spar stru tures with wrap-around beaded skin riveted at the trailing edges. Indica tions are that ailerons and flaps ma have smooth surfaces in the productio airplanes, utilizing honeycomb bonde components, although this may be hel off for later production.

Wingtips are Royalite molded plast incorporating two degrees twist to d lay the stall, and have an aluminu honeycomb bonded stiffener rib sectio at their trailing edges to provide clos outs for the ailerons.

Elliott estimates that use of hone comb-bonded components has save some 50 lb. over the earlier wing con figuration using conventional multi-spa and ribs makeup.

Fuselage Construction

Fuselage is made up of a nose sectio containing the powerplant; cabin se tion comprising upper and bottom com ponents, and an aft section.

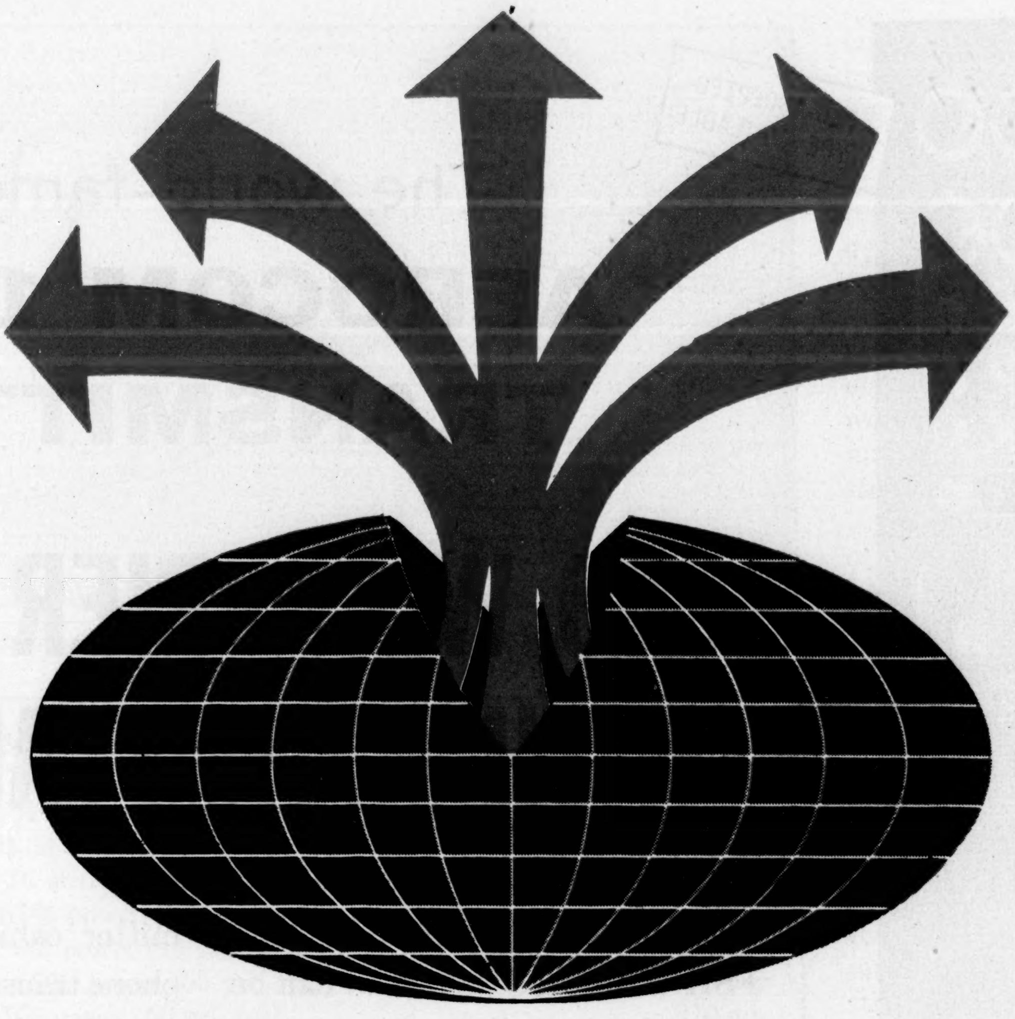
Engine section is a production entity and when completed comprises installed powerplant and cowling and has con trols rigged and fastened to an engin control plate. This layout permit

Construction Methods

Seriousness with which major business aircraft manufacturers are studying new materials and fabrication techniques, which would completely obsolete current airframe structures, is indicated by new designs recently revealed by Beech Aircraft Corp. and Piper Aircraft Corp.

Significance of use of aluminum honeycomb bonded components in Beech Model 23 Musketeer goes much further than its current limited application in this one design. One high management source in this company indicated to Aviation Week that this technique will be extended, not only in future models of this particular airplane, but could feed as well into important structural components of other airplanes in the Beech line, including present and future models. Beech owns considerable metal honeycomb bonding equipment acquired initially to handle military subcontracts.

Similar thinking is evident in research Piper management has initiated with its new two-place all-plastic PA-29 (AW Nov. 27, p. 104), which technicians at its Vero Beach, Fla., facility believe will be applicable throughout the entire line of airplanes this company has or contemplates.



EARTH SCIENCES AT DRESSER ELECTRONICS,

NATURALLY!

Since 1945 Dresser Electronics has been solving instrumentation problems associated with earth probes—first to find oil traps for petroleum geophysicists, now also to provide immediate answers to vital defense and security problems. A sample of present contracts—

for: **U.S. GEOLOGICAL SURVEY (Major Crustal Studies Project)**—Long-Range Recording Systems for VELA UNIFORM program.

DEPT. OF DEFENSE (Civil Defense)—an Automatic Radiation Monitoring System.

USAF (ARPA)—development and prototype of Unmanned Seismic Station.

US ARMY (Signal Supply Agency)—instruments and field studies relevant to seismic techniques for Missile Impact Location.

USAF (Systems Command/Hanscom Field)—development of VLF Electronic Seismometer with possible lunar probe application.

Dresser/SIE systems engineering is also at work in other projects throughout military, industrial and defense areas.

The unique approach of this systems-oriented company may solve your problem.

DRESSER ELECTRONICS

SIE DIVISION / ONE OF THE DRESSER INDUSTRIES

10201 Westheimer, Houston 42, Texas

FCC-ACCEPTED
TYPE AVAILABLE

The world-famous

AEROCOM 1046 TRANSMITTER

1000 W CARRIER POWER WITH HIGH STABILITY

The Aerocom 1046 Transmitter is designed to give superior performance for all point-to-point and ground-to-air communications. It is now in use throughout the world in climates ranging from frigid to tropical (operates efficiently at −35° to +55° Centigrade).

As a general purpose High Frequency transmitter, the 1046 supplies 1000 watts of carrier power with high stability (above −10° Centigrade: ±.003% for telegraph and telephone. Temperature controlled oven for FSK). Multi-channel operation is provided on telegraph A1, telephone A3 and FSK (Radio Teletype). It can be remotely controlled using one pair of telephone lines plus ground return with Aerocom Remote Control Equipment. Front panel switches and microphone are included for local control.

Four crystal-controlled frequencies (plus 2 closely-spaced frequencies) in the 2.0 - 24.0 megacycle range can be used one at a time, with channeling time only two seconds. Operates into either balanced or unbalanced loads. The power supply required is nominal 230 volts, 50 - 60 cycles, single phase.

The housing is a fully enclosed rack cabinet of welded steel, force-ventilated through electrostatic filter on rear door.

Telegraph keying (A1): Up to 100 words per minute. Model 1000 M Modulator (mounts in transmitter cabinet) is used for telephone transmission; a compression circuit permits the use of high average modulation without overmodulation. Model 400 4 Channel) exciter is used for FSK.

Output connections consist of 4 insulated terminals (for Marconi antenna) and 4 coaxial fittings Type SO-239, which can be used separately or in parallel in any combination. For 600 ohm balanced load, Model TLM matching network is used, one for each transmitter channel.

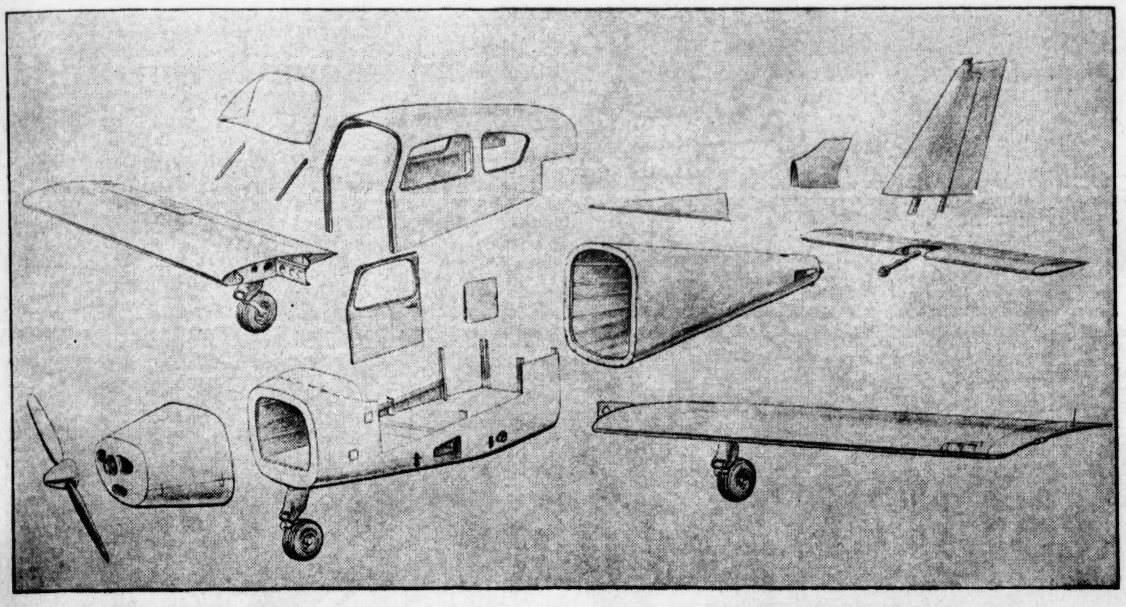
As in all Aerocom products the quality and workmanship of Model 1046 are of the highest. All components are conservatively rated. Replacement parts are always available for all Aerocom equipment.

Complete technical data on Aerocom Model 1046 available on request.

Also available—Aerocom Model 446 with 350 watts nominal carrier power and Model 100TFA—100 watts

AER-O-COM

3090 S. W. 37th AVENUE MIAMI 33, FLORIDA



EXPLODED VIEW shows main structural components of the Beech Musketeer.

Beech 23 Musketeer Performance*

Maximum speed at sea level at 2,700 rpm.	146 mph.
Cruise speed at 7,000 ft. at 75% power	138 mph.
Cruise speed at 10,000 ft. at 65% power	128 mph.
Range at 10,000 ft. at 65% power (40 gal. fuel)	640 mi.
Range at 7,000 ft. at 75% power (40 gal. fuel)	610 mi.
Range at 10,000 ft. at 65% power (60 gal. fuel)	980 mi.
Range at 7,000 ft. at 75% power (60 gal. fuel)	920 mi.
Rate of climb at sea level at rated 160 hp.	700 fpm.
Stall speed (flaps down 30 deg.)	60 mph.
Takeoff distance over a 50-ft. obstacle	1,420 ft.
Service ceiling	15,500 ft.

* Preliminary estimates based on initial flight tests. Based on gross weight of 2,300 lb.

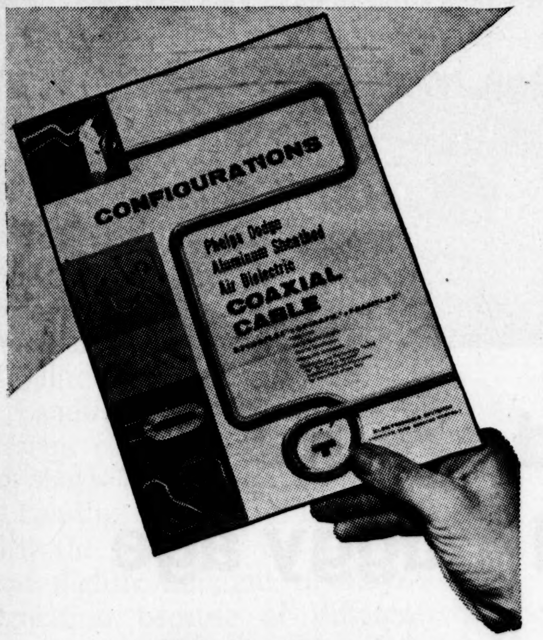
fastening the control plate with four screws to the instrument panel, attaching plumbing and fastening the power package with four bolts to the center fuselage. Pre-rigging of engine controls reduces assembly time and simplifies detachment and attachment of this equipment following engine removal.

Powerplant is also readily removed to provide full access to the airplane flight controls and instrument panel or for work on the nosewheel gear. Engine nose cowl is a single-piece molded and stiffened Royalite plastic section.

Cabin section—44-in. wide—consists of a basic keel formed by the floor and lower skin with longitudinal members, rolled side skins and stringers, and a non-structural top. This top area contains the only stretch-formed double-contour skin used on the entire airplane. Loads are taken off the cabin top by tubular sections coming off engine mount pickups.

Cabin door, on right side, is an aluminum frame bonded to flat skin. Static test fuselage had a cutout incorporated on left side also, to ensure strength of structure would be sufficient to enable incorporation of a second door without major modification, should this be a desirable feature in future Musketeers.

Aft fuselage section is a conventional semi-monocoque structure with main and intermediate frames and is riveted



Write For This Free Catalog!

6 colorful, fully illustrated pages on new, expanded applications for Phelps Dodge Styroflex®, Spirafil and Foamflex Air Dielectric coaxial cable . . .

- Delay Lines
- Custom Cut Lengths
- Special Bent Shapes
- Connector Fitting
- Electrical and Mechanical Testing
- Feed Networks

A-T ELECTRONICS, INC.
14 Lawrence Street
New Haven 8, Conn.
Fabricators-Distributors of
Phelps Dodge Coaxial Cable.

See pages 56-57

PROBLEMATICAL RECREATIONS 95

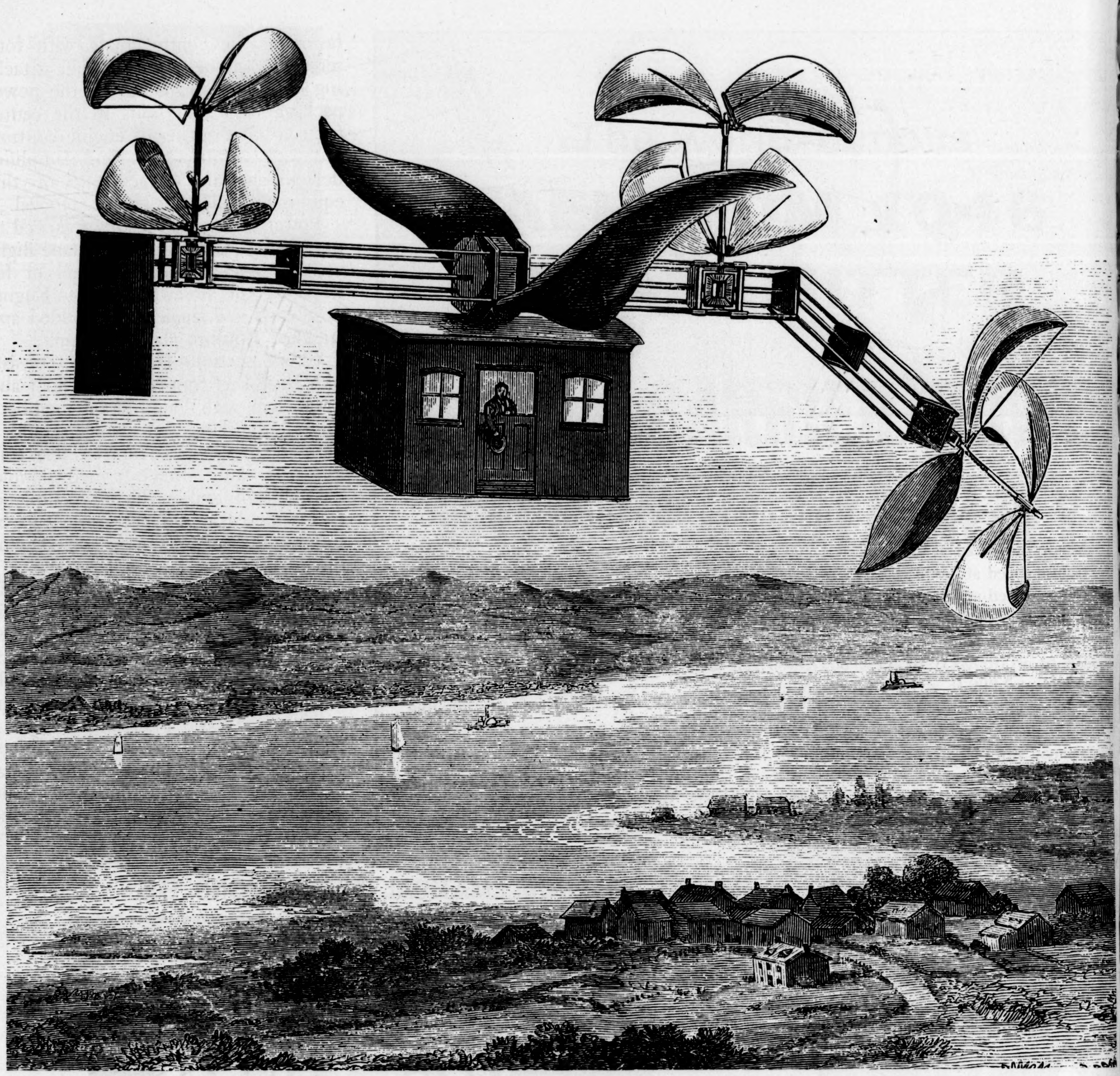
The first expedition to Mars found only the ruins of a civilization. The explorers were able to translate a Martian equation as follows: $5x^2 - 50x + 125 = 0 \quad x = \left\{\begin{matrix}5\\8\end{matrix}\right.$. This was strange mathematics. The value $x = 5$ seemed legitimate enough but $x = 8$ required some explanation. If the Martian number system developed in a manner similar to ours, how many fingers would you say the Martians had?

—THE BENT of Tau Beta Pi

Thumbing through the two new catalogs from our Triad Division we came upon large numbers of transformers of all configurations and characteristics. We suggest you thumb through, too, if you've an application for them. Ask for Catalog TR-62, Industrial Transformers and Catalog TV-62, Replacement Transformers at: Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif. To phone for them, call Upton 0-5381.

ANSWER TO LAST WEEK'S PROBLEM: Bob beat Al by 0.594 sec.

LITTON INDUSTRIES, INC.
Beverly Hills, California



Nickel would have helped create a helicopter in the horse-and-buggy age

When W. J. Lewis conceived this 100-mph flying machine in 1876, he did so in an age that lacked the machines, methods, and materials to make it a reality.

But today, visionary designs are being transformed into practical realities on a virtual day-to-day basis—thanks to advanced technology and modern materials which possess exceptional combinations of physical and mechanical properties.

For example, you might require an alloy casting for highly stressed conditions at temperatures as high as 1900° F.

To solve this problem—and many others requiring good combinations of thermal, mechanical, electrical, and chemical properties—look to alloys containing nickel.

We'll be happy to send you, without obligation, engineering data to help you select the best material for specific aerospace applications. Write to Inco Application Engineering, outlining your requirements.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N. Y.

Inco Nickel makes metals perform better longer

Musketeer Dimensions

Wing span	33 ft.
Chord	52.73 in.
Airfoil section	$63A2415_2$
Incidence (root)	3 deg.
Twist	2 deg.
Sweep	Zero
Dihedral	6.5 deg.
Taper ratio	1:1
Aspect ratio	7.5
Wing area (gross)	145 sq. ft.
Flap area (gross)	18.7 sq. ft.
Aileron area (aft of hinge)	9.9 sq. ft.
Aileron span	32.8%
Flaps span	52.2%
Airplane length	24 ft. 2 in.
Cabin length	10 ft. 3 in.
Cabin width	3 ft. 5 in.
Airplane height	7 ft. 4 in.
Propeller ground clearance	14 in.
Wheel tire size (three wheels)	15-6.00 x 6
Main landing gear tread	11 ft. 9.6 in.
Wheel base	5 ft. 0.8 in.

to the center fuselage. As an example of economy on material and fabrication time, the top section rolled "shoulder" skins have the lower edges bent inwards to act as integral stringers for attachment to frames. Bottom stringers are conventional J-section components.

Vertical tail comprises a three-spar fin having two ribs and wrap-around skins; rudder follows Debonair practice with simple-wrap-around skin covering. Dorsal fin is two pieces, the forward portion being a Royalite plastic fairing.

Horizontal tail is a single-piece "all-flying" type with a single "solid" surface acting as stabilizer and elevator with a full-span anti-servo tab controlling movement off the control wheel. Horizontal tail also is tipped with Royalite fairings.

Landing gears are made up of magnesium castings, utilizing rubber disks for shock absorption.

Landing gears are identical except that the nose gear has a steering arm and slightly different rubber disk configuration because of different shock characteristics—main gears are the same, left and right, except for brake attachment points. Landing gear is stressed to take 3.1 sink speed load factor.

Peru Orders Cessna Fleet for Hinterlands

Government of Peru has ordered 11 Cessnas to be used in a national development program of the Eastern Andean slopes and the plains of the Amazon basin. Included in the $500,000 order: nine Skywagons, five of them float-equipped and two Skyknights, plus spare parts for two years of operation. The aircraft will be delivered beginning in December.

FIELD ENGINEER

We are building advanced airborne and air transportable digital data handling and display systems for air defense. If you understand such systems and can perform customer liaison, training, equipment maintenance, and technical consultation at the customer's site, write to Mr. Harry Laur.

An Equal Opportunity Employer

LITTON SYSTEMS, INC. Data Systems Division
Canoga Park, California

Here is an outstanding opportunity at

AIRLIFT CENTER U.S.A.

Located at Marietta, eight miles from Atlanta

DIVISION ENGINEER

To manage a Division composed of the Propulsion Systems Department and the Mechanical and Hydraulic Systems Department.

Requires broad experience in propulsion systems and sub-systems, which include power plant, engine mounting, exhaust systems, power plant accessories and controls, fire detection and fire protection systems, power plant fluid anti-icing and de-icing systems (including propeller), power plant and fuel heating systems, power plant lubrication systems, fuel systems, oil tanks.

Similar broad experience is required in mechanical and hydraulic systems, automatic flight control systems, servo-mechanisms, boost packages, landing gear design, including anti-skid and nose gear steering systems, heating, ventilating and cabin pressurization equipment and systems, and lubricating systems (other than power plant).

Should have a degree in Mechanical Engineering or Physics, and 15 to 20 years actual experience in the fields noted, at least half of which should have been in supervisory positions.

This is an interesting and challenging position in support of the latest super-cargo airplane (C-141), the JetStar, the C-130, VTOL, and research projects.

Write in confidence to: Hugh L. Gordon, Professional Employment Manager, Lockheed-Georgia Company, Department JJ-75, 834 West Peachtree Street, Atlanta 8, Georgia.

An Equal Opportunity Employer

LOCKHEED-GEORGIA COMPANY

A Division of Lockheed Aircraft Corporation

Piper Seeks Lower Aircraft, Radio Costs

W. Palm Beach, Fla.—Active development program is being conducted by Piper Aircraft Corp. to add new models of single and light-twin business and utility airplanes to its line in the near future, but the company has no plans to get into rotary wing, VTOL or turbine-powered types of any kind, Research and Development Vice President Howard Piper told company distributors and dealers here.

"We are restricting our R&D activities to projects which have about 90% chance of being successful . . . we aren't spending any of our restricted and valuable time on projects that aren't almost sure things," Howard Piper stated.

Research Expansion

At the same time he noted that the company is greatly expanding its research and development activities, at both Lock Haven, Pa., and Vero Beach, Fla. A 41,500-sq.-ft. engineering building, costing approximately $1 million and doubling former facilities at Lock Haven, has recently been completed to handle studies of future multi-engine and high-performance single-engine airplanes.

Current programs indicate that the company will be introducing these new airplanes to its line over the next year and a half, all of which will be complementary to the line rather than replacements of any current types:

- **More powerful Comanche**, already in flight test, has the new eight-cylinder Lycoming 720-cu.-in. fuel injection engine rated at 380 hp. at 2,475 rpm. and 400 hp. at 2,650 rpm., providing a considerable performance increase over the 180-hp. and 250-hp. models and giving the company a single-engine type that would be at least 20 mph. faster than any comparable airplane on the market today, he said. Speed actually would be a secondary factor in the new airplane, he noted—the extra power would provide capability to carry 132 gal. of fuel, permitting very long range at economical cruise speed. The eight-cylinder 380-hp. Comanche should be able to fly 2,100 mi. or 13 hr., burning about 10 gph. and the extra power would also be useful in getting the airplane to optimum cruise altitudes quickly.
- **"Twin-Comanche,"** which is probably 18 months from production, also is being tested in experimental configuration with two 160-hp. Lycomings having fuel injection systems, providing low-engine silhouette and enabling the engines to be cowled in slim nacelles for low drag. This airplane is seen by Piper as competing with Cessna's new model 336 Skymaster pusher-tractor type.

Howard Piper also stated that the new four-place Cherokee "has lots of possibilities," adding that "you'll be seeing many things done with this airframe before long."

He noted that flight tests are being conducted with an Edo-float-equipped Cherokee, but that it was too early to say whether prices of this equipment and cost of certificating such an installation would make it economically practical.

He stated that he didn't feel that turboprop or turbojet engines would be practical for Piper's type of airplanes for many years to come, "if then." It would be necessary to pressurize the airplane cabin to take advantage of the high-altitude performance of these engines, he pointed out, and even then, turbine powerplant prices would have to be cut 50-75% and specific fuel consumption by about one-third to make them reasonable from Piper's standpoint.

Aircraft Cost

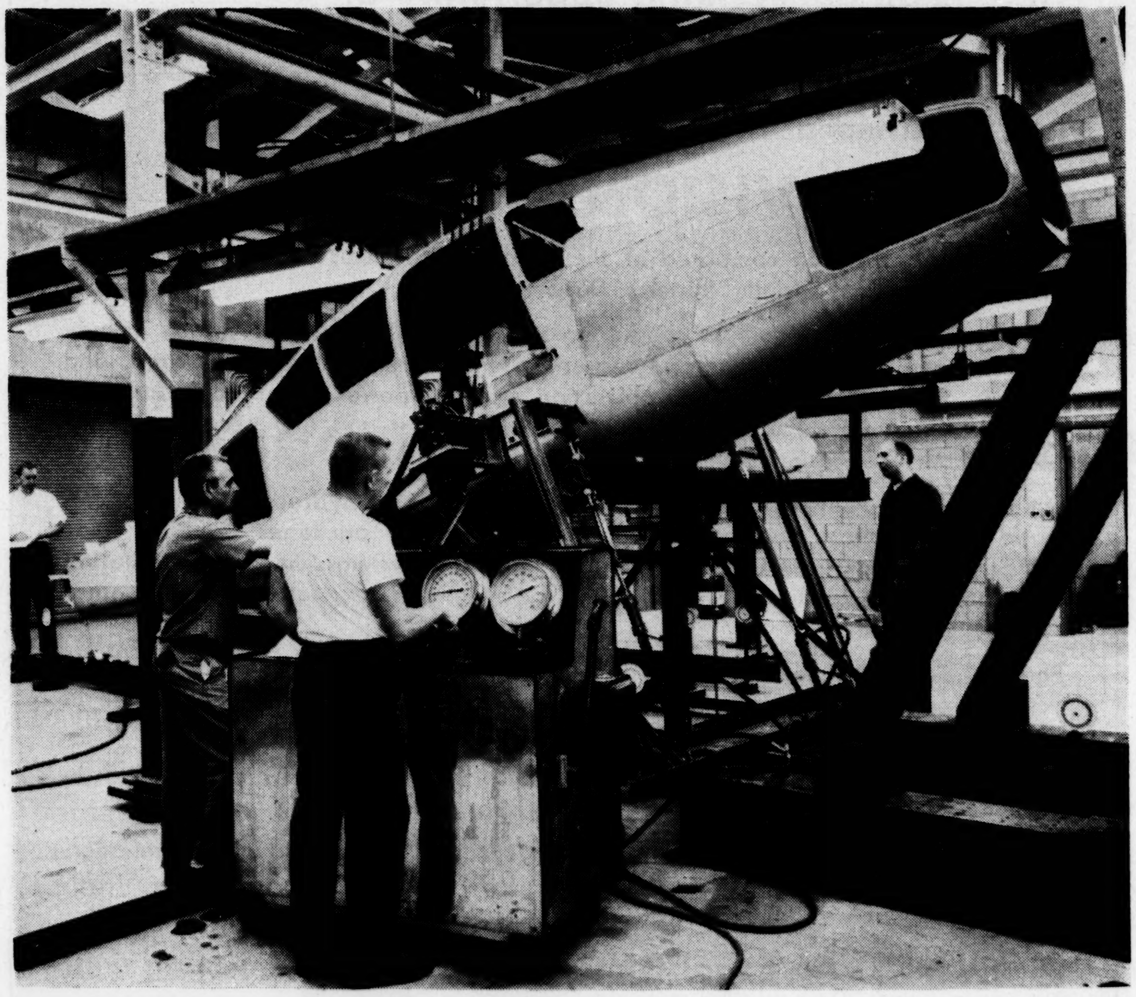
In passing reference to the company's new all-plastic PA-29 project (AW Nov. 27, p. 104), he noted that "not only do we feel that aircraft are far too expensive and need to be constructed in such a way that the price can be much more reasonable," but also emphasized that cost of "much of the equipment is way out of line."

"If we can get an exclusive right to a piece of equipment that is lower in price or better in some way than what the competition has, obviously we have a sales advantage for our airplanes," the Piper executive noted. He went on to state that the company's Electronics Division at Vero Beach, was established with just this principle in mind. "We have felt that the customer is not getting his money's worth in radio equipment, and that by taking a few large steps in that direction, we could advance his welfare and help sell our airplanes as well."

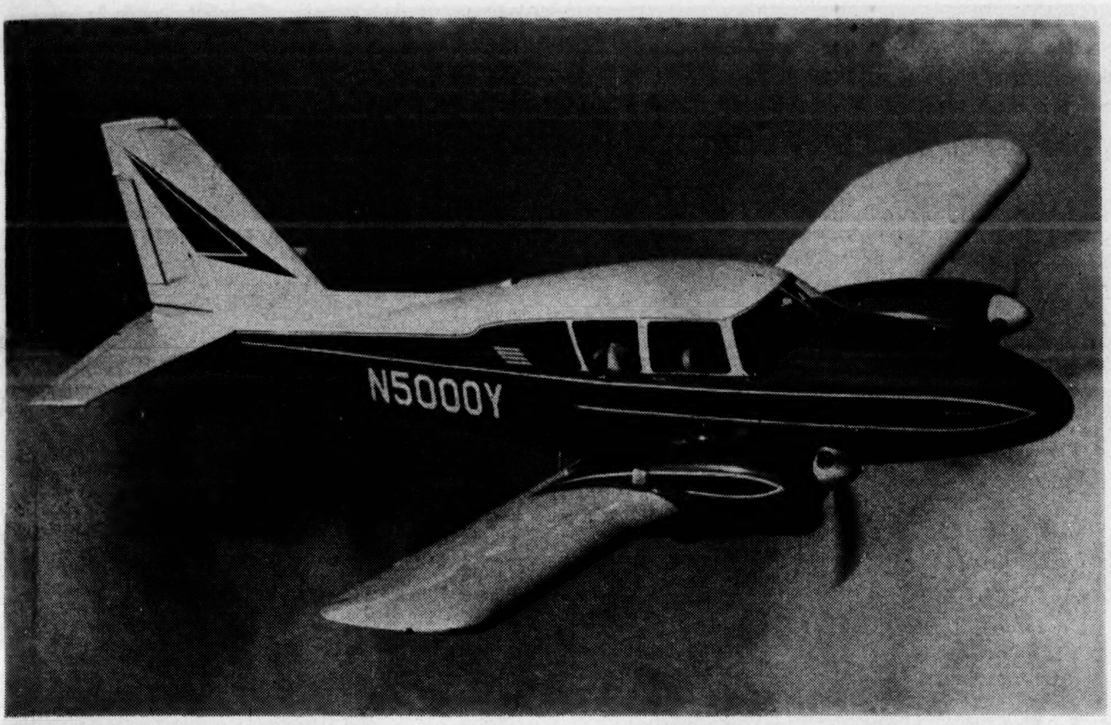
Electronics Equipment

Piper Electronics started with a simplified low-frequency direction finder, selling for about $400 installed, aimed for use in the lower-cost single-engine airplanes, such as the Colt, and Cherokee. The Piper executive indicated that the company started off this program on the wrong foot by promoting it for use in the Comanche line, which it now feels is too sophisticated an airplane for the simplified AutoNav unless all the pilot wants is a basic homing device.

A more sophisticated version of this equipment, with more automatic features, will be developed in the next



LOAD TRIALS on the fuselage of a 1962 Piper Aztec B are performed in the static test laboratory of new Piper engineering building at Lock Haven, Pa. The facility has experimental fabrication section, electrical equipment laboratory and a styling department where fabrics and paints are tested.



LONGER NOSE containing a new 17.75-cu.-ft. baggage compartment and redesigned cabin capable of seating six persons mark the 1962 Piper Aztec B.

year or so, according to Howard Piper.

Next equipment to be offered is a VHF transceiver with omnirange indicator, to sell for approximately $600. Minus the localizer and marker beacon, this is also aimed as a standard installation for the lower-priced Piper airplanes. Shown at the meeting here, the PTR-1 incorporates a transistorized power supply.

The receiver has a nominal output of three watts with tuning range from 108 to 128 mc.; transmitter has a nominal power output of two watts and incorporates 28 crystal-controlled channels.

Indications are that Piper Electronics Division technicians have in mind a broad range of future equipment—Aviation Week learned that among projects under consideration is low-cost airborne radar.

New Aztec

Highlight of the 1962 model presentations here was the latest version of the Piper PA-23 Aztec, which has a redesigned cabin and a new, two-and-a-half-feet longer nose section.

New cabin layout provides three rows of two seats, with the first two rows being individually adjustable fore-and-aft on their floor tracks and the middle seats having three-position reclining backs.

New layout not only increases passenger capacity by at least one person—previous models were four or five seaters—but boosts baggage capacity measurably.

The new forward compartment in the nose provides 17.75 cu. ft. of space loading through a 30.5-in. x 19.5-in. door and the rear compartment, with an area of 20.25 cu. ft. loads through a 22.25-in.-square door.

New cabin layout permits conversion of the airplane, by removing all five passenger seats, to a cargo type capable of hauling 1,150 lb. with full tanks, Piper noted.

Of considerable interest to distributor-dealer personnel was the fact that despite these changes, the 1962 Aztec B retains the earlier price of $52,990 for the standard-equipment fitted airplane, not including radio. The Super Custom version, which includes a full ADF 2½ communications system, will list at $58,460.

PRIVATE LINES

Shipments of business and utility aircraft by eight U. S. manufacturers during September totaled 443 units having a net factory billing value of $9,479,000, bringing the total aircraft in this category delivered to dealers and distributors in the first nine months of this year to 5,029 units valued at $93,948,000. Point of interest—Piper passed the 1,000-mark in shipments of its two-place "compact" Colt in the first nine months figures.

Fleet of five Cessnas is being used by Gulf American Land Corp. to help sell homesites to prospective buyers at the company's Cape Coral, Fla., real estate development. The development company claims 30,000 homesites have been sold in the past three years with the aid of free flights over the new city.

Radar-equipped DC-3, equipped to seat 15 persons, has been given to the University of Illinois by an anonymous donor. Prof. Leslie A. Bryan, director of the university's Institute of Aviation, estimated the aircraft, including electronic devices already installed, to be worth $125,000. The DC-3 is the largest airplane in the university's fleet of 43 aircraft.

U.S. Business & Utility Plane Shipments

August 1961

Make and Model	No. of Units	Factory Billings
Aero Commander 500 A, E	6	$810,000
560F	2	
680E, F	3	
Beech 18 Super	4	$3,558,000
33 Debonair	6	
35 Bonanza	17	
50 Twin-Bonanza	2	
55 Baron	11	
65 Queen Air	8	
95 Travel Air	15	
Callair A-5	2	$14,000
A-7	1	
Cessna 150	15	$1,691,000
172, Skyhawk	27	
175, Skylark	4	
180	7	
182, Skylane	32	
185 Skywagon	19	
210	2	
310	3	
320 Skyknight	4	
Champion 7FC Tri-Traveler	3	$59,000
7GCB Challenger	4	
7GCBA Agricultural	2	
Mooney Mark 21	36	$670,000
Piper PA-18-150 Super Cub	25	$1,990,000
PA-22-108 Colt	125	
PA-23-160 Apache	1	
PA-23-250 Aztec	8	
PA-24-180 Comanche	5	
PA-24-250 Comanche	26	
PA-25-150 Pawnee	12	
PA-28-160 Cherokee	23	
Totals	460	$8,792,000

Note: Monthly totals in number of units and dollar volume represent the lowest thus far in 1961, showing the effects of some slowdowns to prepare for 1962 model changes, particularly in the case of Cessna, which is unveiling its new line the end of October. Unit deliveries and factory billing totals this year through August comprise 4,586 aircraft valued at $84,469,000 compared with 5,290 aircraft valued at $104,994,000 in the same period last year.

WRIGHT CORPORATION
CURTISS DIVISI
CURTISS-WRIGHT
PROPELLER DIVISION

We have changed our name to "CURTISS" DIVISION

For upwards of a quarter of a century, the Propeller Division paced the progress of thrust conversion with its precision propellers and controls. Now as the "Curtiss" Division, it will continue its tradition of quality products for defense and industry on a broader scale.

The Curtiss Division can trace its ancestry back in a straight line to Glenn H. Curtiss, whose pioneering with aircraft and aircraft equipment led directly to the establishment of Curtiss Airplane and Motor Company in Buffalo, N. Y. Late in the 1930's, the Propeller Department of the Company was relocated as a division of Curtiss-Wright at Caldwell, New Jersey.

Propeller design and manufacturing continue to be a substantial part of the division's activities. New, lightweight, fiber glass blades, pioneered by Curtiss-Wright, are making a scientific technological contribution to the VTOL/STOL field — and the manufacture of Electric and Turbolectric propellers represents a large continuing part of the division's production.

But, as we proceed further into the Aerospace Age, the techniques developed and perfected during 35 years of precision propeller manufacture have been applied to mechanical control, actuation, power transmission and stabilization systems for land, sea and aerospace equipment; as well as research with VTOL aircraft.

Therefore, we have changed our name to the Curtiss Division — not only to indicate that our production capabilities and engineering applications have been broadened, but to honor a great aviation pioneer, Glenn H. Curtiss.

CURTISS DIVISION
CURTISS-WRIGHT
CORPORATION
Caldwell, New Jersey

WHO'S WHERE

(*Continued from page 23*)

Changes

Dr. **John A. McManemin**, manager of corporate development, General Precision, Inc., Tarrytown, N. Y., subsidiary of General Precision Equipment Corp.

Eugene W. Norris, assistant manager of The Boeing Co.'s Washington, D. C., office.

Warren R. Smith, manager, NASA and FAA Affairs, for the Washington, D.C., office of the Defense Electronic Products of Radio Corp. of America.

Theodore J. Roemer, manager, Propellant Development Department, Rocket Power, Inc., Mesa, Ariz.

Dr. **R. E. Malm**, manager, Research and Development Department, Apparatus Division, Texas Instruments, Inc., Dallas, Tex., and **A. Ray McCord**, manager of the Division's Surveillance Department.

Earle V. Gardiner, avionics manager, Aircraft Electronics Operation, Pacific Airmotive Corp., Burbank, Calif.

Joseph A. Ricca, manager of planning, Electronics Operations, Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif., and **Charles H. Sword**, manager, Operations Staff for Electronics Operations.

Dr. **Peter M. Kelly**, head, Instrumentation and Electronics Department, Astropower, Inc., Costa Mesa, Calif., a subsidiary of Douglas Aircraft Co., Inc.

Fred A. Speaks, assistant to the president, Canoga Electronics Corp., Van Nuys, Calif.

Algert G. Grimaila, chief engineer-space technology, Western Center, Motorola Military Electronics Division, Scottsdale, Ariz.

Matt Gatzweiler, manager of planning and procurement, Aircraft Division, Aeroquip Corp., Jackson, Mich.

Vernon R. Rawlings, general manager of the newly established Missile Site Activation Organization, Denver (Colo.) Division of the Martin Co.

James R. Scales, manager-marketing research, Borg-Warner Controls, Santa Ana.

Gene R. Marner, director of research, Cedar Rapids (Iowa) Division of Collins Radio Co., succeeding **Ralph McCreary**, now on the staff of the Division's vice president.

William F. Sauers, assistant to the president of Autonetics, Downey, Calif., a division of North American Aviation, Inc.

Robert P. Chase, chief of flight operations for Civil Air Transport (CAT).

John W. Downs, general manager of Radiation, Inc.'s newly created Radiation at Orlando (Fla.) Division.

Dr. **Murray I. Disman**, manager-microwave tube development, Microwave Tube Division, Eitel-McCullough, Inc., San Carlos, Calif.

Robert L. Hammon, manager, Reactor Test Engineering Department of Edgerton, Germeshausen & Grier's Las Vegas (Nev.) facility.

Fairchild Semiconductor's Research & Development Laboratory, Palo Alto, Calif., has appointed **Dr. C. T. Sah**, head of the Physics Section, and **Phillip Ferguson**, head of the Device Development Section.

Charles G. Gant, general operations manager of Penetration Aids, Ford Motor Co.'s Aeronutronic Division, Newport Beach.

Control and Instrumentation Engineers

A key research and development program is now underway at Atomics International to design long-life, compact, lightweight nuclear reactors that will provide auxiliary power systems for space applications. Many interesting problems exist to challenge electrical engineers who want to relate their present experience to reactor technology in any of the following areas:

FLIGHT INSTRUMENTATION DESIGN

Electrical control system design and/or aircraft or missile flight instrumentation design. Will establish flight instrumentation requirements, block diagrams for flight and test systems, preliminary specifications for each instrument or subsystem.

TELEMETRY

Responsible engineers to analyze, plan and specify the telemetry required to ascertain the performance of nuclear power plants during space tests. The individuals must have experience in missile instrumentation and telemetry of temperature, vibration, acceleration, etc. BS or MSEE preferred.

CONTROL ANALYSIS

Dynamic and control analysis including system start-up and full power operation. BS or MSEE plus familiarity with latest analog and digital techniques required.

CIRCUIT DESIGN

Electronics engineers experienced with both vacuum tube and magnetic devices to design and develop control circuits for compact nuclear power plants.

All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

For specific details write: Mr. J.Y. Newton, Personnel Office, Atomics International, 8900 DeSoto Avenue, Canoga Park, California.

ATOMICS INTERNATIONAL
DIVISION OF NORTH AMERICAN AVIATION

GD
GENERAL DYNAMICS
FORT WORTH

OPPORTUNITIES IN

CONCEPTUAL, SYSTEMS ENGINEERING

AND ADVANCED RESEARCH

Reconnaissance Systems electronic, photo or infrared reconnaissance systems; photo and infrared instrumentation; Elint simulators • **Radar & Microwaves** advanced radar systems, coherent Doppler data processing radars; satellite tracking and telemetering; communications; MASERS or LASERS; electromagnetic theory; information theory; radar cross section measurements; antennas, RFI • **Computer Design and Data Management** airborne digital or analog computer design for use with navigation and guidance systems, equipment programming, command and control; data recording; data displays • **Advanced Navigation and Guidance** for high performance aircraft and space vehicles; satellite trajectory computation and prediction; satellite re-entry and recovery • **Data Processing and Communications** ground based systems for reconnaissance data processing, point-to-point data transmission and communications network; data processing system display and presentation techniques; computer design • **Advanced Research** PhD's preferred for theoretical-experimental studies in: cryogenic devices, electronic microminiaturization, optics, hyperthermal research, astrogeophysics, applied mathematics, mobility research, nuclear shielding, space radiation, radiation effects • **Operations Research** weapons systems analysis; military operations and logistics planning; managerial and industrial applications; economic analysis, prediction and planning; cost analysis; mathematical probabilistic and statistical model development • **Also current openings in:** structural loads and dynamics, human factors, fluid power control systems.

THROUGH B-58 PROGRAM EXPERIENCE, our engineering staff developed a unique capability in high performance aircraft and electronic systems design. Now, this mature capability is directed to new programs for air vehicles, advanced military weapons and reconnaissance systems, and certain space-oriented development projects. In addition, new emphasis is being given to basic problems in the space sciences through a new and expanding Advanced Research staff. Immediate Senior and Project-level openings are available in the fields listed at left for engineers and scientists with advanced degrees and related experience. All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin. Send a detailed resume of your training and experience to General Dynamics/Fort Worth, P. O. Box 748A, Fort Worth, Texas.

GD

GENERAL DYNAMICS | FORT WORTH

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, DECEMBER 4, 1961

AER-O-COM 104
AEROQUIP CORPORATION 22
AIRWORK CORPORATION 82
ALLEGHENY LUDLUM STEEL CORPORATION 80
AMERICAN AIR FILTER COMPANY, INC., DEFENSE PRODUCTS DIVISION 58
AT ELECTRONICS, INC 105
ATOMICS INTERNATIONAL, A DIVISION OF NORTH AMERICAN AVIATION, INC 111

BARBER-COLMAN COMPANY, AIRCRAFT & MISSILE PRODUCTS DIVISION 77
BENDIX ECLIPSE-PIONEER DIVISION, THE BENDIX CORPORATION 84-85
BENDIX PRODUCTS DIVISION, THE BENDIX CORPORATION 9
BENDIX RADIO DIVISION, THE BENDIX CORPORATION 90
BENDIX SYSTEMS DIVISION, THE BENDIX CORPORATION 24
BOEING COMPANY, THE 44
BORG-WARNER MECHANICAL SEALS DIVISION OF BORG-WARNER CORPORATION 83
BRUSH INSTRUMENTS DIVISION, CLEVITE CORPORATION 3rd Cover

CHERRY RIVET DIVISION, TOWNSEND COMPANY 5
CHICAGO AERIAL INDUSTRIES, INC 16
CRYOGENIC ENGINEERING COMPANY 67
CURTISS-WRIGHT CORPORATION, CURTISS DIVISION 110

DEUTSCH COMPANY, THE—HYDRAULIC COMPONENTS DIVISION 15
DRESSER ELECTRONICS, SOUTHWESTERN INDUSTRIAL ELECTRONICS DIVISION 103

EITEL-McCULLOUGH, INC., KLYSTRON DIVISION 61
ELASTIC STOP NUT CORPORATION OF AMERICA, ELIZABETH DIVISION 73

FAIRCHILD CAMERA & INSTRUMENTS CORPORATION, FACSIMILE PRODUCTS DEPARTMENT 17
FAIRCHILD SEMICONDUCTOR CORPORATION 20

GARRETT CORPORATION, THE—AIRESEARCH MFG. COMPANY 64
GENERAL ANILINE & FILM CORPORATION, ANSCO DIVISION 7
GENERAL ATOMIC DIVISION OF GENERAL DYNAMICS 86
GENERAL DYNAMICS 112
GENERAL ELECTRIC COMPANY, AIRCRAFT ACCESSORY TURBINE DIVISION 4
GENERAL ELECTRIC COMPANY, HEAVY MILITARY ELECTRONICS DEPARTMENT 72
GENERAL ELECTRIC COMPANY, LIGHT MILITARY ELECTRONICS DEPARTMENT 54
GENERAL PRECISION, INC 12-13
GIANNINI CONTROLS CORPORATION 96-97
GOODYEAR AIRCRAFT CORPORATION, THE 3

HAYDON COMPANY, THE A. W 87
HUGHES AIRCRAFT COMPANY 59-60

INTERNATIONAL BUSINESS MACHINES CORPORATION, DATA PROCESSING DIVISION 42-43
INTERNATIONAL NICKEL COMPANY, INC., THE 106

KAYNAR MANUFACTURING COMPANY, INC., KAYLOCK DIVISION 2nd Cover

LING-TEMCO-VOUGHT, INC., ELECTRONICS DIVISION 6
LIQUIDOMETER CORPORATION, THE 76
LITTON SYSTEMS, INC., DATA SYSTEMS DIVISION 107
LITTON SYSTEMS, INC., A DIVISION OF LITTON INDUSTRIES 88, 105
LOCKHEED GEORGIA COMPANY, DIVISION OF LOCKHEED AIRCRAFT CORPORATION 107
LOCKHEED MISSILES & SPACE COMPANY, DIVISION OF LOCKHEED AIRCRAFT CORPORATION 78-79

MARKEL & SONS, FRANK L 55
McGRAW-HILL BOOK COMPANY, INC 99
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, AERONAUTICAL DIVISION 46
MITRE CORPORATION, THE 14

NORTHROP CORPORATION 70-71

PARSONS COMPANY, THE RALPH M 93
PHELPS DODGE COPPER PRODUCTS CORPORATION 56-57
PUROLATOR PRODUCTS INC 10

RADIATION, INCORPORATED 66
RADIO CORPORATION OF AMERICA, SEMICONDUCTOR & MATERIALS DIVISION 98
RAYTHEON COMPANY, EQUIPMENT DIVISION 100-101
REEVES INSTRUMENT CORPORATION 18
ROCKET POWER INC 69
RYAN AERONAUTICAL COMPANY 11

SHELL OIL COMPANY, AVIATION PRODUCTS 40
SIKORSKY AIRCRAFT DIVISION, UNITED AIRCRAFT CORPORATION 8
SINCLAIR REFINING COMPANY 51
SPERRY ELECTRONIC TUBE DIVISION, SPERRY RAND CORPORATION 62-63

TEKTRONIX, INC. 102
TEXAS INSTRUMENTS INCORPORATED, COMPONENTS DIVISION 68

UNITED TECHNOLOGY CORPORATION, A SUBSIDIARY OF UNITED AIRCRAFT CORPORATION 119

VARIAN ASSOCIATES, TUBE DIVISION 4th Cover

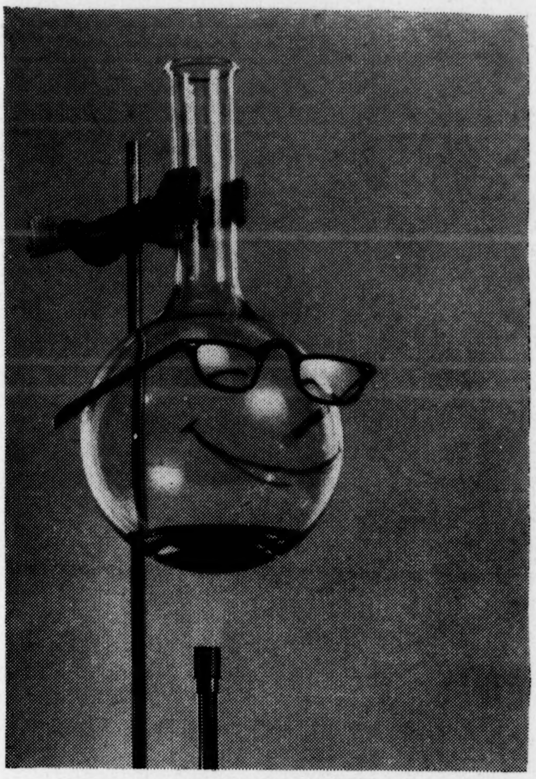
CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

WHERE TO BUY
  Graphic Systems 118
EMPLOYMENT OPPORTUNITIES 113-117
EQUIPMENT (Used or Surplus New)
  For Sale 118

ADVERTISERS INDEX

Atlantic Aviation Corp 118
Berry Associates Inc 113
Boreas Corp. 118
Cornell Aeronautical Lab., Inc 114
Curtiss-Wright Corp. 114
General Electric 117
I B M Corp. 116
Northrop Corp. 118
Pratt & Whitney Aircraft 115
Raytheon Company 113
Thiokol Chemical Corp 114



If it isn't fun, don't do it!

Do you *enjoy* your work? Or do you wait till after hours to have your fun? Ponder that a moment.

Those who get ahead, you'll observe, are nearly always those who get a real kick out of what they do. They find their assignments challenging, stimulating, and rewarding—not only in personal satisfaction but in the financial sense, too.

If you're missing these elements in your present job, we invite you to take a look at the possibilities here at UTC.

We have a sense of mission and a dedication to the advanced propulsion goals we're striving to achieve. But we also recognize that if a man has zest for his assignment he will give the most of himself and get the most for himself. That's why UTC's research and development groups are purposely small, encouraging free exchange of ideas, direct guidance from technical leaders and proper recognition of individual performance.

If you are interested, we invite you to contact Jay Waste, Dept. No. 116, United Technology Corporation, Box 358, Sunnyvale, California. All replies treated in strictest confidence.

All qualified applicants considered without regard to race, creed, color or national origin.

UTC

United Technology Corporation

UA

SUBSIDIARY OF UNITED AIRCRAFT CORPORATION

LETTERS

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Wasteful Procurement

The recent re-emphasized pressure upon the Department of Defense by the Congress to achieve a high percentage of competitive procurements (100% is the stated goal) in defense buying must result from a lack of possession of the facts by members of the Congress. While it would appear at first glance that defense monies will be more efficiently and effectively spent if all buying were competitive, there are four factors which make such procurement practices unwise.

1. Competitive bidding requires considerably longer procurement cycles than negotiated procurements in certain instances —in some cases delays that can only be made up by heavy overtime expenditures and other inefficiencies.
2. Re-orders frequently cannot be economically procured other than from the company already tooled and experienced in the equipment production—thus competitive bidding may be more expensive.
3. Excessive competition may well cost the government considerably more in indirect costs than the nominal cost saving that shows on the procurement documents.
4. Technical effort expended on unsuccessful proposals is a direct and complete waste of the best engineering capability within the defense industry.

While the principle of our free enterprise system is based upon open competitive bidding by anyone reasonably qualified, the tendency towards unrealistic and excessive competition in several branches of the defense industry frequently results in 25 to 40 proposals prepared for a single research and development program. The effort required to perform the study, experimentation and analysis to prepare and publish a typical proposal costs from a few thousand to several hundred thousand and in some cases over a million dollars. There have been recent instances of 30 companies responding to a request for proposal for a $250,000 development contract. Each proposer spent a minimum of $15,000, thus a total of no less than $450,000 was expended collectively for a $250,000 program.

This proposal money is justly written off in general and administrative or overhead expenses, which means that it is apportioned to costs on other government defense contracts.

Thus DOD pays the bill if only indirectly.

But even more significant is the tremendous waste of the nation's most highly talented engineering and scientific manpower which results from excessive competitive bidding. It is well known that all companies employ their best and most experienced talent working on advanced systems and techniques in the effort leading to the preparation of proposals. If a company is to survive. and get at least its share of the business it is competing for, it is forced to employ its best manpower in this fashion. It has gotten so extreme, because of excessive competition, in certain branches of the defense industry that the only personnel available to work on the contract efforts won are the younger, less experienced engineers and scientists.

In seeking possible solutions to this situation, consider the evaluation process. The 30 proposals are usually reduced to three to five from which the final selection is made. The others are discarded as unacceptable or marginally acceptable and are not seriously considered further. Thus, it would appear that the competition could well be restricted to the four or five bidders who present recommended or acceptable entries. The problem reduced itself to—how can these five best qualified bidders be selected for the competition?

There are several possibilities. Submittal of qualifications and capabilities, both technical and management, by all interested would permit the selection of the four or five best qualified. The preparation of this initial submittal and its evaluation should not take more than two weeks, after which the principal competition effort can begin.

Another approach which appears of interest is the payment of nominal sums for the proposal effort so that the technical ideas of the unsuccessful bidders among the most qualified can be applied to achieve the amalgamation of the best ideas and approaches by the successful bidder in the best interests of the government. If the government pays the nominal costs of the qualified bidders it has the right to use the material it obtains in the proposals. This is precisely what is done in certain study programs at the present time. In more complicated or complex technologies, initial study programs can be awarded to the two to five most qualified for the execution of the first phase of the program. The company putting forth the best effort would be selected for the continuation and completion of the program. Again, because government funds were utilized by all initial participants, the best approaches and techniques could be combined and utilized by the successful participant.

When such concepts are considered, objectors frequently suggest that this process will equalize the competitive factors which have fed and made our economy healthy. However, this procedure is none the less competitive than present open bidding. Any company wishing to enter a new field has only to acquire the necessary skills by training or acquisition and investing a portion of its available funds. In order to provide for new entries into established fields, equal consideration must be given in evaluation to self-funded work as to contract work.

These concepts are not new; they have been used periodically by the military procurement agencies in special instances from time to time. What is suggested here is more widespread application on a broader base to eliminate much of the current waste of a precious national resource—our best scientific and engineering effort.

S. L. Katten
Philadelphia, Pa.

Windshield Failures

As you undoubtedly know, Major Robert White's two most recent record speed flights in the X-15 have been marred by windshield failures. Inasmuch as I have received numerous inquiries about these failures, I would appreciate your printing this letter to clarify the matter.

The X-15 windshield assembly contains two completely separate panels. The outer one is a ½-inch thick slab of heat-resistant glass, which is essentially non-structural and serves only as a heat shield. The inner panel is a glass laminate with a heat-resistant silicone interlayer. This inner panel carries the cabin pressure, and also contains a transparent electrically-conductive coating, which heats the windshield to prevent fogging during certain portions of the flight. Incidentally, the inner panel is protected from the full effects of aerodynamic heating by both the outer heat-shield and a stream of nitrogen which circulates between the two panels, so that the inner windshield gets no hotter than about 350°F.

In each of the two recent failures, only the outer heat-shield shattered, while the electrically-heated pressurized inner panel continued to function normally. It is probable that the severe aerodynamic heating (in excess of 1,000°F.) either expanded the glass heat-shield sufficiently to interfere with the mounting structure, or produced excessive thermal distortion in the mounting structure, which caused the heat-shield to shatter. (Note that both failures occured during or after the speed run, contrary to the report in your Nov. 13 issue (p. 33), that the second failure occured "during drop from the 'mother' B-52.") Major White suffered considerable loss of visibility in both cases, an uncomfortable situation to be sure, but he did not lose cabin pressure, nor was he in any immediate danger thereof.

Although we at Sierracin supplied only the inner pressure windshields for the X-15, we are vitally interested in any problems occurring with the outer heat-shield, inasmuch as re-entry heating problems will become increasingly common in manned vehicles. In being the first aircraft to suffer windshield problems related to re-entry, the X-15 is serving its basic purpose, which is to explore problems of high speed flight at extreme altitudes, so that later aircraft can perform similar missions safely and routinely.

G. L. Wiser
Vice President, Engineering
The Sierracin Corp.
Burbank, Calif.